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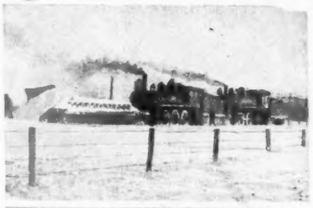
Q & C RAY SNOW FLANGERS

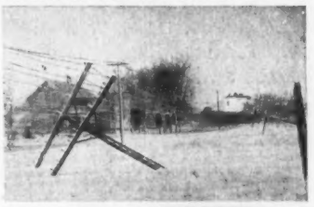


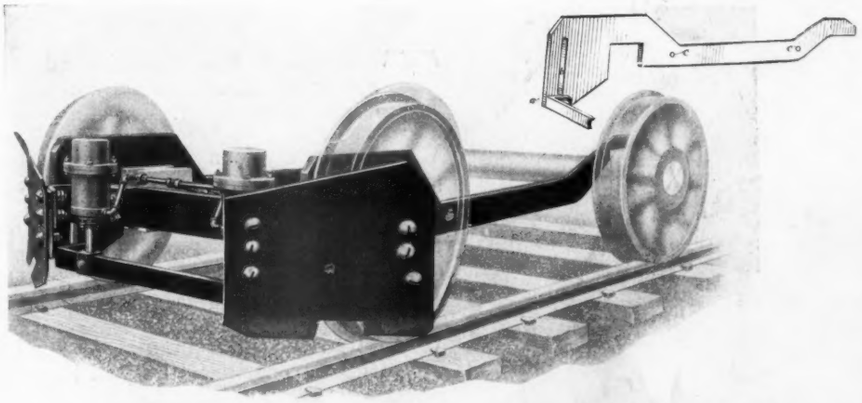
BE PREPARED

Don't wait until the road is blocked with snow, causing great delay and expense.

THE RAY FLANGER

will keep the line open, effecting a clean flange way and full tractive effort. Can be variously applied to locomotives or cars without taking them out of service.





THE Q & C COMPANY

NEW YORK—90 West Street & **CHICAGO**—Peoples Gas Building

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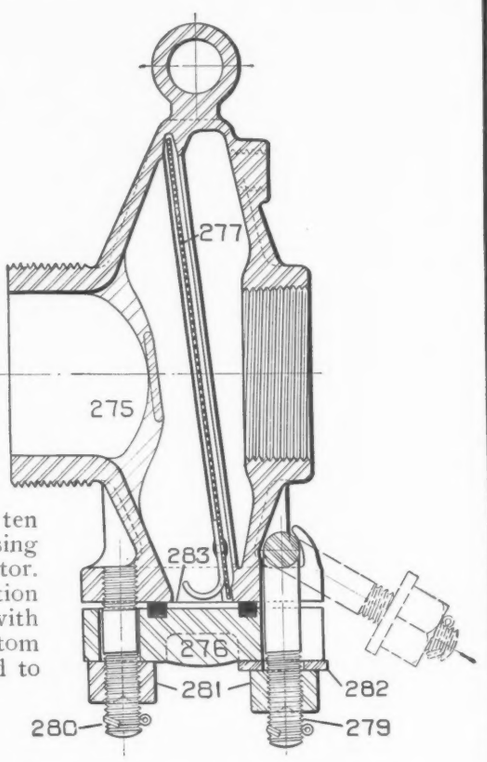
APPLY SELLERS FEED-WATER STRAINERS

AND NOTE REDUCTION OF INJECTOR FAILURES AND COST OF RENEWALS

QUICKEST AND EASIEST TO CLEAN

NOT necessary to detach HOSE to clean. Straining plate ten times the area of a 2" suction pipe; low velocity of water passing through 3/32" perforations prevents fine particles entering Injector. Baffle Plate (No. 275) prevents foreign material entering suction pipe when cap (No. 276) removed for flushing. Bottom caps with inserted gasket, tight with light pressure on bolts. Large bottom dirt trap renders frequent cleaning unnecessary. Manufactured to fit all sizes and styles of HOSE NUTS and INJECTORS.



LABOR SAVING MACHINE TOOLS

LOCOMOTIVE INJECTORS —— VALVES —— SHAFTING, Etc.

Pedrick Tool & Machine Co.

3641 N. LAWRENCE STREET

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Ten Years Ago Railway Shops Found This Machine Solved Pipe Bending Problems

THE result has been its adoption by entire systems; sixteen machines for one road, a dozen for another, etc., etc.

Why haven't you a Pedrick Pipe Bender in your pipe-shop, doing work easier, better and quicker?

The machine may be easily taken to any part of the shop without bothering about steam or air lines. One former makes any angle up to 90 degrees. It's simple in operation and is not expensive.

We only await your inquiry to send additional information—so write while you have the thought in mind.

Manufacturers Portable Cylinder Boring Bars, Portable Crank Pin Turners, Portable Millers, etc.

Railway Mechanical Engineer

Volume 90 December, 1916 No. 12

The Prize Competitions

It was our intention to announce in this issue the winners in the prize competitions on hot boxes under freight cars, and the benefits of convention attendance. Unfortunately the judges were unable to come to a conclusion as to the winners in either of these contests and we are forced to postpone announcement of the results until the January issue. We are greatly in hopes, however, that the decisions in both competitions will be made shortly and that we will be able to notify the winners and send out the checks early in December.

The Making of an Executive

In studying recent annual reports of the railways four distinct improvements stand out because of marked economies which they have brought about. Without attempting to list them in the order of their importance they are, (a) increased average trainloads, which are far greater in proportion than any increases which may have resulted directly from the introduction of new and larger power, from the modernization of old locomotives, or from reduction of grades and curves; (b) marked reductions in the amount of fuel used on locomotives per unit of work done; (c) heavy reductions in the amounts paid out for loss and damage to freight; (d) a gratifying decrease in the amounts expended for loss of life and injuries.

Many things are responsible for these various savings; but underlying it all is one great force—that of education. These things were not accomplished by any one man, or any group of men. They have been fruitful only in so far as everyone having anything to do with them has been awakened to his responsibilities and has been shown how to do his particular work in a way to get the best results. Many means have been taken to bring about this awakening. Obviously, the officers first had to awaken and gain a vision of the possibilities. Publicity campaigns of one sort or another were waged. Above all, however, was the personal work done by those in charge in instructing their subordinates as to details and inspiring them to co-operate and help with their criticisms and suggestions.

Some roads have done more than others; some shops and divisions on the same road have gone far ahead of others because of their leaders and the knowledge they have been able to impart and the spirit that they have been able to inspire in their followers. It is true that in many instances material, equipment and improved facilities have played an important roll, but far more vital than these has been the better use which has been made of the human material. And this does not mean exhausting or overworking the individual. In most cases the spirit in which the task was approached by the individual really made his work easier than before. It has required a greater expenditure of brain energy and possibly less physical effort. It has caused many discouraged individuals to take a real pride in their work and to realize the possibilities and responsibilities of their positions. We are only beginning in this country to realize the necessity for the conservation of human energy, as well as of physical energy and materials. No matter what your position may be you can find plenty of opportunities to improve the work of your gang, shop or department, if you will go at it in the right spirit. Begin with yourself and then get busy on the men under you.

Machining Locomotive Journals

The necessity of removing the "dead" metal from punched holes in firebox sheets before applying the staybolts is generally acknowledged. That the same principle applies to locomotive axles and other similar parts of cars and locomotives is clearly brought out in the report of the investigation made of a locomotive axle failure published elsewhere in this issue. The sole cause of this accident is attributed to the fact that the finishing cut on the journal did not remove the "dead" metal caused by the heavy roughing cut taken in turning down the axle from the rough forging. This left a surface that could not withstand the bending stresses to which the axle was subjected. This surface metal gave way forming cracks in the axle itself which gradually grew larger until the axle broke.

The theory of the behavior of the axle, as presented in the report, is that the surface metal of the journal was in tension, thus tending to open up cracks in its structure, whereas had a proper finishing cut been taken and the journal properly rolled, the surface metal would have been in compression, thus resisting the bending action instead of augmenting it. This point should be carefully considered in all round parts that are subjected to a similar action. Time may be saved by taking heavy roughing cuts but sufficient metal must be left so that the finishing cut will remove all of the "dead" metal and further, where necessary, the parts should be rolled to insure a close grained metal structure.

Other points brought on in the inspector's report also showed that the general workmanship in making this axle was poor. The wheel had a very small bearing in the wheel seat, which would have caused an accident later on, and mistakes had been made in the location of the keyway.

Locomotive Headlight Hearings

On September 1 the Interstate Commerce Commission extended until January 1, 1917, the effective date of the order requiring all new steam locomotives and all steam locomotives given a general overhauling subsequent to that date to be equipped with high power headlights with sufficient intensity to enable persons with normal vision in the cab of a locomotive, under normal weather conditions, to see a dark object the size of a man for a distance of 1,000 ft. or more ahead of the locomotive. A hearing was held at Washington during the week beginning October 30 to consider a series of tests made with electric headlights on the New York Central. Oral argu-

ments were also heard by the commission, and briefs filed, on November 27.

As will be noted elsewhere in this issue, a number of startling facts were brought out during the hearings. It is difficult to explain the position which has been taken by organized labor in advocating the adoption of the high power headlight. While it may have advantages on single track lines in sparsely settled districts of the country where traffic is light, there seems to be little question but what it is absolutely dangerous on double or multiple track lines with a heavy density of traffic. Although evidence which was presented clearly proved that the Brotherhood of Locomotive Engineers, through Grand Chief Warren S. Stone, had expelled members from the brotherhood because they had testified against the use of the high power headlight, at least 80 engineers were on hand in Washington to testify that the use of such headlights was dangerous. It is reasonable to suppose that they would hardly have taken this step at the risk of losing their insurance and other rights in the organization and incurring the displeasure of their fellows had they not held very strong convictions on the subject.

It is hard, also, to understand the attitude of the locomotive boiler inspection department at Washington in working so intimately with the brotherhood leaders in advocating the use of the high power headlight. Nor can one understand why Alonzo G. Pack, assistant chief inspector in the locomotive boiler inspection department, should, almost within the hearing of the Interstate Commerce Commission, remind one of the engineers of the brotherhood rule that he could be expelled for interfering with legislative matters of the brotherhood. There is in the federal penal code a section which prescribes a fine of $5,000 and six years' imprisonment for intimidation or wrongful influencing of witnesses in a proceeding before a United States court or commissioner. The brotherhood leaders should be made to feel the force of this law.

It is fully realized that the members of the Interstate Commerce Commission are overburdened with duties, but in justice to the railroads it is to be hoped that each of its members can find time personally to study over the evidence which was presented at the hearings. If this is done the department of locomotive boiler inspection will undoubtedly be ordered to modify the proposed rule on high power headlights, which is not only unreasonable but dangerous, despite the assertion made by Grand Chief Stone that such headlights should be considered as a "safety device."

Promotions in the Mechanical Department

The following poem, which appeared in a recent number of Power, relative to the advancement of men in minor positions in the stationary engine field applies so thoroughly to the mechanical department of our railways that through the courtesy of Power we present it to our readers. There is a lot of truth in the poem and it should be carefully considered by all mechanical department officers, from the highest to the gang foreman. To most people there is something more to life than a mere three square meals a day. A man will work harder and more conscientiously if he feels that there is a possibility of future advancement in the particular line of work which he is following. Nothing is more discouraging than to bring in outside men to fill the positions immediately ahead of him. Where this is the practice the proper esprit de corps will never be obtained, and, further, it is an indication of poor organization, for no shop or department can be considered well organized in which there is not a man in the organization who has been brought up and trained to fill the openings in the administrative ranks as they may occur.

The poem speaks of the fireman in the stationary plant, but any position in the mechanical department of a railroad can be substituted for that of the fireman and the poem will still hold good.

THE JOB HIGHER UP

By R. T. Strohm

There are times when toil grows dreary
And the world seems none too kind,
And the worker's frame is weary
With the long-continued grind;
And the thing that keeps him going
When his nerve and strength have fled
Is the hope that comes with knowing
There's a better job ahead.

He is sure to be more willing
And less apt to lag and droop
If he knows that oil-cup filling
Or the swinging of a scoop
Will not haunt the years remaining
With its humdrum, but, instead,
Give experience and training
For the better job ahead.

He will throw his best endeavor
Into every phase of work,
And the chances are he'll never
Be a loafer or a shirk
If his modest occupation,
Though it yields him meat and bread,
Is a sort of preparation
For a better job ahead.

Nothing kills his high ambitions
Quite so thoroughly as when
He observes advanced positions
Go to new and unknown men;
So you really cannot blame him
If his spirit's dull and dead,
When you don't intend to name him
For the better job ahead.

The Situation at Washington

When President Wilson surrendered to the brotherhood chiefs last September he insisted that Congress should enact a law to provide not only for the establishment of an eight-hour day and the appointment of a small body of men to observe the actual results of the adoption of the eight-hour day in railway transportation, but also that the Interstate Commerce Commission should be enlarged; that Congress should consider the question of an increase of freight rates to meet the additional expenditures; that provision should be made to prevent strikes or lockouts until arbitration had been resorted to; and also that the chief executive should have the power, in case of military necessity, to take control of the railroads and rolling stock or such portions of them as might be necessary, for military purposes. It is understood that in his message to Congress, which will be presented before this issue reaches its readers, he will insist that the legislation on this program which was not attended to in September be given prompt consideration.

Meanwhile a test case as to the constitutionality of the Adamson eight-hour law has been rushed to the Supreme Court in the expectation that arguments will be heard and a decision will be handed down before the law becomes effective on January 1. Even should it become effective, a long time must elapse before it can be definitely decided just what it means and how it should be applied.

In addition to all this, the Newlands or Congressional Joint Commitee on Interstate Commerce opened hearings on November 20 with a view to investigating the entire problem

of railway and public utility regulation. These hearings will extend over a considerable period and will be of a most comprehensive nature. The railroads were called upon first to state their case and make such recommendations or suggestions as they might think wise, and several days were required for the presentation of testimony by Alfred P. Thom, counsel for the Railway Executive Advisory Committee. Briefly, the railroads are in favor of a fair and stable system of regulation and to secure it they advocate that the entire power and duty of regulation should be placed in the hands of the national government, except for local or incidental questions that can be more easily handled by state authorities. An enlargement of the Interstate Commerce Commission is recommended, as well as the creation of a new federal railroad commission and regional commissions in order that prompt attention may be given to all questions which may arise in connection with railroad rates and regulation. This would make it possible for the commission to confine the suspension of rates to 60 days from the time the tariffs are filed instead of 10 months as at present. The federal incorporation of railways is also advocated, as well as giving the federal government exclusive power to supervise the issuance of securities by interstate carriers.

With all of the above mentioned agencies at work upon the railroad problem the next few months promise to be critical ones in the history of railroading. If action is taken which will provide for constructive instead of restrictive and corrective regulation, and if measures are adopted that will insure fair treatment of the railways, so that investors may be attracted instead of being repelled, it will mark a distinct advance. If, on the other hand, the present situation is allowed to remain unchanged or a narrow policy is followed, the country at large must surely suffer, for in order to extend its productive territory and have its citizens efficiently served, the railroads must very greatly increase their equipment and facilities and must enjoy at least a fair degree of prosperity.

Do Your Equipment Buying Early

Elsewhere in this issue figures are given showing that the railways and other users of cars and locomotives in the United States and Canada placed orders during November for 408 locomotives, 44,001 freight cars and 510 passenger cars. It is also noted that during the month orders were reported as having been placed with locomotive builders for foreign locomotives to the number of 755, or a total of both foreign and domestic locomotives of 1,163.

These purchases made November the best month, as far as new business in railway cars and locomotives is concerned, in at least the last three years. In fact, the domestic orders for locomotives exceeded those reported in the entire first six months of 1915, while the freight car total was greater than that for the first seven and one-half months of 1915. The November orders added appreciably to the 1916 totals. Domestic orders for locomotives so far reported this year now total 2,538 as compared with a total in all 12 months of last year of 1,612. Freight car orders to November 30, this year, now total 142,399 as compared with 109,792 from January 1 to December 31 last year. Passenger car orders now total 1,462 exclusive of subway, elevated and Pullman cars as against a similar figure for 12 months in 1915 of 1,467.

The amount of business that is being done in railway equipment will be even better realized when it is observed that in November contracts were reported for over $100,000,000 worth of cars and locomotives. There were 408 domestic locomotives which, considering the large number of heavy locomotives ordered, may be put at $30,000 each, a total of $12,240,000; 44,001 freight cars at $1,500 each, $66,001,500; and 510 passenger cars at about $18,000 each, $10,800,000, a total of domestic orders of $89,041,500. To this will be added 755 foreign engines at something like $14,000,000. In short, the purchases of cars and locomotives reported in a short 30 days have totaled, according to these conservative estimates, no less than $103,041,500. Truly, our car and locomotive plants next year, should be showing us annual reports that will put the "war brides" in the shade.

Bear in mind that these enormous purchases are being made while prices for cars and locomotives are from 25 to 40 per cent above their normal level and while deliveries are exceedingly poor. In fact, a railway ordering equipment at the present time cannot expect delivery before June or July, 1917. The equipment market during the summer of 1916 was fairly good, but at all times there was a decided drag because of high prices, as evidenced, for example, by the large number of withdrawals of inquiries. During these months the railways could have financed heavy purchases, but they could not see their way clear to placing large contracts while there was still some chance that prices would fall again or while there were possibilities that the cars and locomotives would not be delivered before the war-time business and revenues had fallen off. It has now become apparent that no decline in prices is to be expected for some time. This and the fact that as new orders are placed, deliveries will become poorer and poorer, present the incentive for the present rush of business. The railway that has not already contracted for its requirements for many months ahead should take good note of these conditions. It can apparently gain but very little by postponing its purchases even a little while longer.

The amount of shop equipment purchased by the railways does not perhaps present quite so bright a picture as is furnished by cars and locomotives, but there is reason for gratification that the railways are now beginning to get into the market. The railways need equipment badly as a direct result of their present great activity, and it is only because of high prices and poor deliveries that they have not issued large lists of their requirements. How long they could hold off from buying tools has at all times been problematical. It is now evident that they should not hold off much longer. To be sure, deliveries are still poor though not as bad as they were. Prices are still high; they are from 40 to 70 per cent higher than they were a year ago. But as in the case of cars and locomotives, the end does not appear in sight. The railway that has not covered its machine tool requirements should "watch its step."

NEW BOOKS

How to Build Up Furnace Efficiency. By Joseph W. Hayes. Tenth edition. Bound in paper. 158 pages, 5 in. by 7 in. Published by the author, Rogers Park, Chicago, Ill. Price, $1 postpaid.

The first edition of this book was published in 1908 and the fact that this is the tenth edition published within a period of eight years is sufficient evidence that it has been very widely read. The author is a combustion engineer, who has several publications to his credit, dealing with the technical phases of combustion and fuel economy. In the present volume, however, the aim of the author has been to treat the subject in a popular way, very little being said relative to the theory of combustion. The purpose has been to show the manager, the superintendent and the engineers and firemen of power plants, how they may proceed actually to effect economy in the consumption of fuel with results which will be felt immediately in reductions in the coal bills. The book is written in a breezy style and is well illustrated with drawings and diagrams. It also contains illustrated descriptions of such equipment as draft recorders and apparatus for gas analysis, with instructions for their use as a means of checking furnace efficiency.

COMMUNICATIONS

TOBESURA WENO ON THE HEADLIGHT LAW

(With apologies to Wallace Irwin.)

DEAR EDITOR:

In my previous epistle, I express grave fear of possible impeachment my job I. C. C. Federal detector. Since which I are about convince circumstance deal me four ace. I refer to headlight law by honorable commission. Some time since, big mechanical bugs confab with Chief Detector at Washington, secret test are made by prominent western RR supervised by Federal detectors under I. C. C. code prepared for occasion and entire different from crude, unscientific scheme use by federation of R.R. officials which manufacture report for amusement Atlantic City mm convention. Aforesaid scientific test develop that propose light must consume enough currents, kilowatts and mean spherical candle powers to cause normal brotherhood engineer in normal atmospheric atmosphere to detect normal dark man on track 1,000′ ahead of cattle-guard when electric headlight are in normal state of preparedness. This rule No. 29 emitted by Hon. I. C. C. embody four condition of normality which are same as drawing four ace to poor jap detector like yours truly.

Dear sir, you being educated editor see quick there is 28 illegal combinations in four normalities mention—so Federal detector have same number chance to put embargo on smart-aleck mm. You understand when I flag unlimited express and inspect headlight, engineer declare he see object on track 1,000′ I reject appeal immediate account not normal night-moon and stars shining. Or on dark night, engineer see man on track 1,002′ away; R.R. representative laugh exulting and say O.K. but I unable to accept—man not normal dark object because he are white man, face and hands not normal dark and he sport straw hat. In same way, I can report engineer not normal on account he have cat eyes or atmosphere not normal on account dew or fog which magnify headlight beam like telescope and bring object close to view. Or, I say track not normal as dark object only 500′ around curve and headlight over in corn-field.

So I have regain courage and equanimity also ability to look sassy. Rule No. 29 are going to be salvation to Federal detectors. Yours truly, TOBESURA WENO.

BROADEN YOUR VISION!

LAS VEGAS, New Mex.

TO THE EDITOR:

It seems to me that the able articles in the recent issues of the *Railway Mechanical Engineer* and the Railway Age Gazette by J. T. Anthony on fire-box design and G. M. Basford on the subjects that should invite the best thoughts and efforts of young railway men of today must be productive of a great deal of good. Mr. Anthony ably traces the evolution of the firebox and considers the things that are needed to make it still more efficient. How many men will this appeal to and set thinking deeply with the set purpose of adding something to the sum total of the knowledge of the mechanical world on this most important subject? Too few, I am sure. I regret to say that the most besetting fault of railway mechanical men among those of "lower rank and lesser renown" is not to think deeply of the subjects that are most vital to the railway welfare. By far the greatest single item in railway outlay for material is the cost of fuel, and each and every thing that we can do, no matter how trivial, to reduce the sum total of this cost is well worth doing; if the thousands of mechanical men who have a direct opportunity could each add his mite the results would be indeed gratifying. No doubt we cannot all go to the heart of the matter and materially increase the efficiency of the firebox but some of us can and the rest of us can each do our part toward saving fuel and keeping the power in condition to obtain the maximum of efficiency with the minimum of expenditure.

Thinking of our calling in this way has another beneficial effect. It ennobles our profession in our own eyes, adds dignity to the humblest task and gives us an added zest and interest in life. I sometimes wonder if railway men are less attached to their calling than other men; how many thousand times do we hear men lamenting the day that they began a railway career, and yet the fact most likely remains that they have received more of the comforts of life for the efforts they have expended than they could have in any other calling, and their discontent is solely due to the fact that they have not taken an honest personal inventory and feel themselves under-rated.

It is axiomatic that a chain is no stronger than its weakest link and an organization is no stronger than the thought and heart-felt interest of the rank and file of its personnel. When we can get the sub-foreman and his mechanics to feel a deep interest in the appliances that have been developed for saving fuel; when they will study the brick arch and give it in their minds the prominent place that it rightly deserves; when they will look upon a successful feed-water heater not as a new fangled "contraption," but as a real money saver; when they will set their minds and hearts to work on the development of pulverized fuel which is to be the real money saver of tomorrow; when they will enthusiastically approve the modern apprentice system so ably developed by Messrs. Purcell and Thomas; when they will give earnest thought and effort not only to the needs of the mechanical department but to the necessities of the operating department as well, then indeed will our progress be marked and rapid and then, too, will railway men be more content and happy in their work because an enthusiastic man cannot be other than a happy one.

Another effect of the study of our profession as outlined by Messrs. Thomas and Basford will be to raise the social status of our calling, thus making it easier for us to secure the highest class of young men to recruit our work and to take up our burdens when we are no longer able to bear them. I believe the most subtle influence at work in the last decade to prevent the better class of young men from becoming mechanics has been a certain form of snobbery that decries against a man in overclothes. This, I believe, is passing away and the sturdy words recently uttered by Charles M. Schwab, that bare hands grip success better than kid gloves, are indicative of a feeling that is growing and that should be fostered.

Going back to the first proposition, I believe that such articles as those of Mr. Anthony, Mr. Thomas and Mr. Basford will do a world of good because they will teach railway men to think more deeply of the great problems involved in what I feel may be rightly termed the science of mechanics and of men, and I do not think any greater good could be done by railway officials than to induce every earnest thinker and worker to become a subscriber and a student of the leading railway magazines, magazines that disseminate all that is soundest and best in modern railway theory and practice.

T. T. RYAN,
Division Foreman, Atchison, Topeka & Santa Fe.

EXPORTS OF RAILWAY SUPPLIES.—Exports of railroad supplies from the United States for the seven months ending with July amounted to $36,215,000, as compared with $9,465,000 for the same period of the preceding year, according to the statement issued by the Department of Commerce. Railway cars increased in value from $1,767,000 to $18,093,000, largely because of the purchases made by the Russian government for the equipment of its new lines, which have been rushed during the war. Locomotives numbered 363, of which 111 went to Europe, 39 to Canada, 70 to Cuba, 21 to Mexico, and 72 to Russia.

TRAVELING ENGINEERS' CONVENTION

Reports and Discussion on Handling Freight Trains, Assignment of Power and Superheaters

THE report of the proceeding of the first part of the convention of the Traveling Engineers' Association at Chicago was published in the *Railway Mechanical Engineer* of November, page 561. Following is a report of the remaining sessions:

SUPERHEATER LOCOMOTIVES

[The question of the advantages of superheaters, brick arches and other modern appliances on large locomotives, especially those of the Mallet type, was continued over from last year, the report of the committee remaining substantially the same. This will be found in the *Railway Age Gazette, Mechanical Edition*, for October, 1915, page 499, under the heading of Modern Appliances on Large Locomotives. The discussion of the report this year centered on the subject of superheaters.—Editor.]

W. A. Buckbee (Locomotive Superheater Company):—In some instances where superheaters have been applied to locomotives and no other change has been made in the design of the locomotives, it has been found that the tonnage can be increased about 10 per cent. The reason for this is the increase in boiler capacity and the shorter cutoff at which the engine may be run. It is well known that the efficiency of the superheater increases the harder the engine is worked, which means that the steam supply is greater. In many cases the diameter of the cylinders has been increased with the application of superheaters, but where this is done the factor of adhesion must be carefully considered. In some cases it is advisable to increase the cylinder diameter and to decrease the boiler pressure, keeping the same tractive effort. This not only saves fuel, but also increases the life of the boiler. As to whether or not superheater engines will start a train better than a saturated steam engine, it has been found that with the cylinders hot, superheater engines of the same tractive effort will start a train that a saturated steam engine will not. The reason for this is that the steam will pass through the cylinders without being condensed. In the saturated engine the steam that is condensed in the cylinder evaporates back into steam as soon as the pressure has been reduced sufficiently and thus produces a large volume of steam which must be forced out through the nozzle. With the superheater engine this is not so and for that reason the nozzle sometimes is reduced in area. By heating the cylinders of superheater engines by passing steam through them and out through the cylinder cocks a much smoother and easier start can be made with long heavy trains that have been standing for some time.

F. P. Roesch (E. P. & S. W.):—In order to obtain the full benefit of superheated steam in locomotives the engines must be so maintained that the full amount of superheat will be obtained. A pyrometer is absolutely necessary to determine this. When the temperature of the steam is below 570 deg., the economy is not being obtained. The difference between the correct temperature and an inefficient temperature is so hard to detect in the operation of locomotives, especially where they are used in pool service, that no engineer can be expected to tell whether or not he is getting the proper degree of superheat without a pyrometer. The superheater flues should be kept clean, and the water should not be carried too high in the boiler. On the El Paso & Southwestern a foaming water is used which if carried too high in the boiler will pass over into the superheater units, and deposit scale on the inside of the tubes, which, of course, decreases the efficiency of the superheater. This can only be detected, however, by the use of the pyrometer. Steam leaks in the cylinder should also be watched carefully. Superheated steam is thinner than saturated steam and will pass through smaller openings. It is more difficult to determine these classes of leaks on superheater engines than it is on saturated engines. Steam should be admitted to the cylinders when drifting in order to give them the proper lubrication. From investigations of drifting valves we have found that a drifting valve sufficient to keep the relief valve closed at 37 m. p. h. requires just about one-half a ton of coal per day, which, in our district, means approximately $2.30. We find that the brick arch is absolutely necessary in connection with the superheater if full benefits from its use are to be obtained. By the use of the arch 40 deg. more superheat is obtained than when the arch is not used, and on starting this difference is 100 deg.

L. R. Pyle (M. St. P. & S. S. M.):—We find that it is necessary for superheater engines to be equipped with drifting valves, and have found them to be cheaper than working steam when the engine is drifting. The relief valves are closed entirely. The fireman will be able to fire a locomotive better where pyrometers are used. He does not have to rely on the boiler gage at all. If he can keep his engine up to the proper degree of superheat he will have no difficulty in keeping up the proper boiler pressure.

B. J. Feeny (I. C.):—The condition of the locomotive boiler changes so slowly that it is impossible to detect it without the pyrometer. It has been found that 9 out of 10 holes in the smokebox, through which the outside steam pipes pass on superheater engines, become leaky. This has been stopped by calking these openings with asbestos packing.

Other members spoke on the efficiency obtained from the use of superheater locomotives. On one road where 20 engines have been converted to superheaters with no other change, the slide valves and the Stephenson valve motion being retained, the tonnage handled by the engines was increased from 3,600 to 4,000, with the working pressure of the boiler reduced from 200 lb. to 185 lb. The engines do not have to be worked any harder. It was believed by some that due to the absence of condensation in the cylinders, and also to the higher degree of temperature of the cylinders, the mean effective pressure of a superheater engine was higher under the same conditions as a similar locomotive using saturated steam. It was generally reported that better time could be made and more tonnage could be handled with the superheater engine at a lower fuel and water consumption. In Mallet engines it has been found that the temperature of the steam in the low pressure steam chest is 15 to 18 deg. hotter in superheater engines than in saturated engines. The question of oil to be used was discussed but it was the general opinion that if the air was kept out of the cylinders while they are hot no trouble would be experienced with the oil.

HANDLING FREIGHT TRAINS

The purpose of this report is to recommend proper methods for making up and handling modern freight trains on both level and steep grades, so that the smallest amount of damage will be done to the draft gear. It may be recommended that:

All passing tracks, stations, water tanks, and, in fact, any place where heavy trains have to stop, should be located on such a grade that the train may be stopped without either severe pushing or pulling action on the draft gear.

All unnecessary stops should be cut out.

The brake piston travel should be kept uniform, brake

pipe leakage be kept down to a reasonable amount, retainers and their piping be kept in absolutely good condition, good pumps be placed on the locomotives which will furnish the necessary air to handle the brakes.

The engineer should be thoroughly instructed in the handling of the brake equipment.

Special attention should be paid to the inspection of draft gear at terminals.

Records should be kept of the individual performance of engineers on train handling, and they should be required to make a written statement as to the cause of the damage to the draft gear on the trains they handle.

Yard Switching.—Much of the damage to draft gear is done in switching. It has been found that when a bunch of cars was coupled up at a speed of 5 m. p. h., there was a buffing stress of 255,000 lb. In taking slack to cut off a dynamometer car, which was 21 cars from the engine, a shock of 78,000 lb. was experienced. It will be seen from this that too much care cannot be exercised in handling cars by all concerned.

The committee recommends that uniform instructions be given to cover local conditions as to the proper manner in which to handle the cars and trains in different yards, also that hand brakes be kept in good condition, so the yard men can stop the cars by them if necessary.

Make-Up of Trains.—The ideal arrangement of a train of empties and loads would be to so alternate them as to produce, as nearly as practicable, a uniform degree of retardation throughout the train, but this would obviously be impracticable. Tests have shown that, where possible, about one-third of the empties should be placed next to the engine and ahead of any loads, or else scatter the loads throughout the train and not allow them to be bunched in any one place.

From the tests it was found that the maximum stress reached under any conditions with a train made up as above was 92,000 lb., while the maximum stress with the loads all behind was 223,000 lb., or two and one-half times greater, and with the loads all ahead 150,000 lb., or 60,000 lb. greater than experienced where the loads were near the middle of the train. A record of the tests above mentioned follows:

Test No. 1.—This test was made with a train of 12 empties, then 10 loads, the dynamometer car and 21 empties. The throttle was closed at a speed of 22 m. p. h. and 30 seconds was allowed for the slack to bunch in the train. A 15-lb. brake application was then made at the engine and the train was allowed to stop. There was a buff of 20,000 lb. when the slack ran in after the throttle was closed and before the brakes were applied, and a final pulling stress of 50,000 lb. just before the train came to a stop.

Test No. 2.—The same make-up of train was used and the same routine was followed, but the brakes were applied when a speed of 15 m. p. h. was reached. The slack bunched and the train was allowed to stop. A buff of 39,000 lb. was experienced when slack ran in, and a final jerk of 92,000 lb. pulling strain was obtained at the moment of stopping.

Test No. 3.—The same train and make-up was used. At a speed of 12 m. p. h., with the slack bunched, the brakes were applied in emergency. A buff of 50,000 lb. was experienced when the slack ran in and a 58,000 lb. jerk at the moment of stopping.

Test No. 4.—The train consisted of 31 empties, the dynamometer car and then 10 loads. At a speed of 22½ m. p. h. the brakes were applied with a 12-lb. reduction immediately after closing the engine throttle. With the train still stretched a buff of 120,000 lb. was experienced and there was a constant pushing strain of 50,000 lb. until the stop was completed.

Test No. 5.—This test was made with the same train, but the slack was allowed to bunch before the brakes were applied, and in bunching after the throttle was closed a buff of 40,000 lb. was experienced with a final buffing strain of 74,000 lb. at the time of stopping.

Test No. 6.—The same train was used and at a speed of 10 m. p. h. the brakes were applied in emergency immediately after closing the throttle, and three buffing shocks were experienced. The first was 223,000 lb., the second was 180,000 lb. and the third was 177,000 lb.

Test No. 7.—The same train was used and a 15-lb. brake application was made at a speed of 11 m. p. h. While the slack was stretched a buffing shock of 87,500 lb. was experienced.

Test No. 8.—The same train was used. When backing up to kick off the caboose, a 9-lb. reduction being made at a speed of 6 m. p. h., two jerks were experienced, one 80,000 lb., the other 120,000 lb.

Test No. 9.—Moving ahead at 4 m. p. h. with the same train, an 8-lb. reduction being made, the buffing experienced was 100,000 lb.

Test No. 12.—The train was made up of 10 loads, the dynamometer car and 31 empties. At a speed of 20 m. p. h. and after the throttle had been closed and the slack allowed to bunch, a 12-lb service application was made from the engine and the train allowed to stop. During this test a constant pulling strain of 150,000 lb. was experienced.

Test No. 13.—With the same train, a 10-lb. service application was made at a speed of 12 m. p. h. When the brakes took hold on the rear end a jerk of 132,000 lb. was had; the train parted by breaking the drawbar in the fourteenth car from the engine and three cars behind the dynamometer car.

EMPTY AND LOAD BRAKE

One of the most fruitful causes of damage to draft gear is the difference in braking power between empty and loaded cars. This is the reason why so much stress is laid upon the importance of mixing the loads and empties in such a manner that the unequal strains will be spread over the train so that it will not do damage.

Braking power on cars varies in different parts of the country from 60 per cent to 80 per cent of the light weight of the car, and drops to from 17 per cent to 30 per cent when the car is loaded. Now, then, if we could get a brake equipment which would give a uniform braking power with both empty and loaded cars, we will be in a position to handle long, heavy freight trains faster and with less damage to draft gear and with greater safety.

In the new empty and load brake, which has been introduced on several roads, we have to a great extent such a brake. On one road the cars have a standard braking power of 50 per cent of the light weight of the car, and when loaded and cut into load position they have 40 per cent of the weight of the car, or a loss of only 10 per cent in braking power when the car is loaded as against a loss of 40 per cent to 43 per cent with the single capacity brake.

The reports concerning this brake indicate that it will increase the hauling capacity of a road handling heavy trains down steep grades and tend to increase the safety of the operation of trains.

Following is a summary of tests of the empty and load brake made with a dynamometer car on the road:

The greater safety, control capacity and economy possible by the use of the empty and load equipment is illustrated by the fact that when the same brake pipe reduction was made with a 90-car train having 30 empty and load brake equipments on the head end, and also with a 90-car train with single capacity brake equipment, both on a tangent of 1½ per cent grade and at a speed of about 21 m. p. h., the train with the empty and load equipment on the first 30 cars was stalled, whereas the speed of the other train was only reduced to about 8 m. p. h. The average brake pipe reductions required to control the 90-car train with the 30 empty and load brake cars on the head end was only half

as great as with the 90-car train of all single capacity brakes. The single capacity brake train could not be re-charged as promptly or as uniformly as the other, because 100 per cent heavier brake pipe reductions had to be made.

The average speed on the grade was about 16½ m. p. h. for the train without empty and load brakes, and about 19 m. p. h. for the train having empty and load brakes (30 on the head end). This shows that a higher speed can be secured, thus increasing the capacity of the road, and at the same time a greater factor of safety in operation is afforded by the use of the empty and load brake equipment.

Just preceding the final application at the foot of the grade with the train having all single capacity brakes, the brake pipe pressure was only 78 lb. instead of 91 lb., as it was at the start. With the similar train having 30 empty and load equipments on the head end the brake pipe pressure preceding each successive application was 93 lb.

With both the 90 and 100-car trains having empty and load equipments there was an average reserve braking force available at all times during the descent of the grade such that at any time the forces being employed might have been increased by from 35 per cent to 55 per cent as occasion demanded. On the other hand, the train without empty and load equipment was being taxed to its capacity throughout the descent of the grade.

The best estimate possible from the data at hand shows that only about 48 per cent of the maximum available air supply was required in the handling of the train having empty and load equipment, whereas it was necessary to use about 54.5 per cent of the maximum compressor capacity for the train not having empty and load equipments.

Emergency stops from 23 m. p. h. on the grades with trains consisting of one locomotive, dynamometer car, six loaded coal cars and caboose (brake on locomotive and caboose cut out) were made in an average distance of 1,780 ft. when the cars were equipped with single capacity brakes. A similar train having cars equipped with empty and load brakes was stopped from the same speed in approximately 720 ft., 40 per cent of the distance required to stop with the single capacity brake.

[The report also included quite complete instructions for freight train handling, including instructions for engineers, train conductors and others who have to do with this work.—Editor.]

The committee is: L. R. Pyle, chairman, (Soo Line); E. F. Boyle, (Sunset Central); W. G. Wallace, (Am. Steel Foundries;) Wm. Owens, (N. Y. Air Brake), and C. W. Irving, (N. & W.).

DISCUSSION

Walter V. Turner (Westinghouse Air Brake Co.):—Where the brake equipment is not properly maintained it is very difficult to give the engineer any definite instructions as to how he should handle his train. Brake piston travel has a very vital bearing on the performance of the brakes, and where this is not maintained to the proper amount it is impossible to get smooth action. It must be remembered that the shocks are caused by the difference in velocity between the cars. This difference in velocity is caused, to a very large extent, by the unequal braking power on the different cars. A difference of one mile per hour in the velocity of two cars produces a shock between the cars equal to the weight of one of the vehicles, provided they are of the same weight. It is therefore very important that the braking power be maintained as nearly constant as possible throughout the train, which means that the piston travel should be up to standard. No brake pipe reduction should be made, such that would cause a difference of velocity between any two cars in the train of 2 m. p. h., as this is almost sure to cause damage to the draft rigging. The best brake is one that produces the least velocity difference between the cars. and which will apply simultaneously; otherwise low reductions must be made if no shocks are to be obtained. To obtain proper train operation it is necessary to start back of the manipulation of the brake valve. In other words, the brake equipment of the cars must be of the proper design and be maintained properly. With the heavier cars in long trains the empty and load brake is found to be necessary. Cars of 315,000 lb. capacity are now being built. If the single capacity brakes were used on these cars it would require a 22-in. brake cylinder to properly brake a 100-car train, and this, of course, is impossible under existing conditions. With the empty and load brake the capacity of the brake is increased 3½ times, and 60 per cent as much air is used as in the 10-in. single capacity brake. The air consumption of the brake system is an all-important factor in the long and heavy trains of today.

The principal feature of the empty and load brake is that it can handle heavier cars at greater speeds and it is just as desirable and necessary for heavy cars in long trains on level track as on grades. It not only permits of better handling of the trains but decreases the cost of maintenance of the cars, inasmuch as they are handled more smoothly. Smooth braking cannot be expected for present day train service from the single capacity brake on account of the inherent defects in its design. The acceptance of the improvements in air brake design has not accompanied the development in car and locomotive design, but it is necessary that they go hand in hand. It is just as important to control the speed of the new equipment as it is to build it.

T. F. Lyons (N. Y. C.):—It pays to make haste slowly in braking the long, heavy trains of today. While the paper recommends two reductions in the train line pressure to make a stop, it appears to me that one reduction would be better, as every time the brake pipe pressure is reduced you take just one more chance on the poor operation of your brakes. Terminal tests are very important and should be made. The use of sand to start sliding wheels rotating again is of no avail and will only increase the length of the flat spot on the wheel. In making coal and water stops in cities where there are many crossings it is better to stop the train and draw it up to the water plug slowly, rather than to cut off from the train and run to the water plug light. By doing this the train will be ready to start after the engine has received coal and water, and will block the crossing for a much shorter time.

F. P. Roesch (E. P. & S. W.):—Break-in-twos are due very often to defects in the draft arrangement caused by rough handling in the yards. It is estimated that fully 60 per cent of the damage to freight equipment originates in the yards. The defective equipment gets out on the road unnoticed, especially at night, when it is difficult to properly inspect the cars. One break-in-two out on the road caused by this defective equipment will attract more attention than a similar accident in the yards, and the engineer is often held to blame when it is really the fault of the men in the yards and the inspectors who let the defective equipment get out on the road.

G. H. Wood (A. T. & S. F.):—It has been found better to work steam on the locomotive close up to the stop on long trains. This will tend to keep the slack out and prevent any trouble from the shock due to the slack running in heavily. It must be remembered that the instructions given by the committee cannot be considered as a panacea for all evils. They show what should be done under average conditions. It is my opinion that fully 75 per cent of the damage to the equipment is done in the yards, and that every means should be taken to prevent any defective equipment from getting out on the road. On the Santa Fe the terminal tests include stretching the train to locate undue slack in the draft arrangement.

W. G. Wallace (American Steel Foundries):—Many of the break-in-twos occurring on the road are occasioned by

improper attention to draft rigging at the terminals. It is important that the draft gears be maintained properly, and that excessive slack be eliminated. It might be well to stencil on the side of the car the proper length of draft gear travel in order that this may readily be determined. The practice of the Santa Fe in stretching its trains in terminals to determine the slack is a very good idea.

H. F. Henson (N. & W.):—Careful supervision of the engineers in handling trains is necessary for good performance. Sufficient time should be given at the terminals for careful inspection and especially upon leaving the classification yards. The engineer is many times held responsible for accidents that should really not be chargeable to him. The knuckle pins should be carefully examined. Many of them are too short for the service they are required to give. For long trains sufficient reservoir capacity should be provided on the engine, and the reservoirs should be kept well drained of water.

L. R. Pyle (Committee chairman):—All the recommendations of the committee are based on the assumption that the brake equipment is maintained properly. We should never ask an engineer to do anything unless the equipment is in condition to do it and that we could not do ourselves. Attention must be given to the handling of the cars in the yards. The number of break-in-twos can be diminished if proper effort, organization and concentration is placed upon it. I know of one specific case where 100 break-in-twos per month were reduced to 26 by simply getting after them and following them up. The traveling engineer should make recommendations concerning the makeup of trains. He is "the eye" of the mechanical department, right on the firing line where he can watch things carefully, and should not hesitate to make recommendations for improvements in the handling of the equipment, for if he don't there is no one so well situated to see these things that will. We must not charge all break-in-twos to bad equipment, of course. There is undoubtedly a lot of it occasioned by improper handling of the train by the engineer.

ASSIGNMENT OF POWER

The officer that assigns the power to the sub-divisions on the system should be a man who understands the construction of the different type locomotives and who also understands the requirements of the sub-divisions on which the power will have to work. This officer should have absolute authority and report direct to either the general manager or superintendent of transportation, or general superintendent of motive power, and should at all times keep in close touch with these general officers. He should have an organization with an assistant or assistants on each sub-division to cooperate with the local officers, and conduct tests with reference to tonnage and fuel economy.

Assigning of power with reference to density of traffic is very important; the less train miles made the most economical the operation. The grade line and the shop facilities for caring for the engines should also be considered. The power should be run to or from some point which has the necessary facilities for caring for it, except in isolated cases of engines working on runs and coming to the shop every one or two weeks, as the case may be.

The assigning of engines with regularly assigned engine crews versus the pooled system, is a most important question, which, to a large extent, is governed by local conditions. It is possible to run engines successfully and economically over more than one division in continued service. This will save terminal consumption of fuel and reduction in mechanical forces at intermediate points. At the end of the engine's run it should be thoroughly inspected and all necessary work done. With our modern passenger engines equipped with brick arches and superheaters it is possible to run them from 200 to 350 miles over two or three divisions. The advantages in assigning regular men on engines would apply where the power is old and facilities for caring for power are limited, such as branch line service and all locals, and on runs that tie up at outlying points.

A number of roads have shown that engines can be pooled successfully and economically, provided there is a proper organization to inspect and repair them.

The condition of power reflects—first, the class of work that the roundhouse foreman will accept from his mechanic; second, lack of personal inspection by the local mechanical officers and failure to keep in close personal touch with the mechanical condition of the power.

ENGINE MILEAGE

Every effort should be made to increase the mileage of the power, the result of which is increased earnings on the capital invested, decreased cost of engine handling and less overcrowding at terminals, which automatically increases the mechanical facilities without increasing the expenditure and reduces the terminal consumption of fuel. The larger earning power created guarantees quicker returns and permits quicker retirement of power. Railway companies are finding that by converting saturated steam engines to superheaters increased mileage can be successfully made.

A recent striking example of what can be accomplished by running power through and over two divisions has come under the observation of the writer on two freight divisions of 120 and 119 miles respectively, making a total of 239 miles. A number of 49,000-lb. tractive effort superheated Consolidation locomotives have been used for several years for handling all freight business, much of which is expedite freight. The freight engines were run through from Springfield, Mo., to St. Louis, crews changing at Newburg, and engines making mileage of 239 miles. A careful check for sixty days, including the months of May and June, showed the following results:

Engines run through made	133,000 engine miles
Engines not run through made	52,000 engine miles
Fuel used per 1,000 gross ton miles, through service	159 lb.
Fuel used per 1,000 gross ton miles, not run through	178 lb.
Saving in favor of engines that went through	$2,611

Equals a saving of 10.7 per cent.

Reduced force at intermediate point, account going through	$1,260
Total for two months	$3,871
At same rate will show annual saving	$23,226

Also, five engines were removed from the division and used elsewhere, in face of increased business of 20 per cent in train miles per mile of road or 246 train miles per mile of road a year ago and 299 train miles per mile of road in 1916 on this territory.

The reason that all engines are not run through is due to grade, line and operating conditions, which require turnarounds to be made.

The following passenger engine mileage is made between terminals before the engine is relieved, one, two and in some cases three crews manning the same engine:

Springfield to St. Louis	239 miles
Springfield to Memphis	282 miles
St. Louis to Monett	283 miles
Springfield to Oklahoma City	304 miles
Sapulpa to Sherman	207 miles
Springfield to Kansas City	204 miles
Springfield to Ft. Smith	178 miles
Kansas City to Oklahoma City	378 miles
Memphis to Birmingham	251 miles
Memphis to St. Louis	318 miles
Monett to Wichita	239 miles
Making an average run of	262 miles

From 6,000 to 10,500 miles per month are made with passenger engines. Taking, for instance, the run from Memphis to St. Louis, 318 miles, four runs are handled with five engines—one to protect. The accumulative mileage will require that one of these engines shall go through the shop every ninety days for general repairs, as every ninety days one of the five engines has made more than 114,000 miles.

To bring about the necessary co-operation of all departments, which is absolutely essential when making power

assignment requiring engines to cover more territory, the endorsement and prestige of the general manager or some other high operating official is required.

Proper inspection, close attention to the work reported by the engine crews and inspectors, proper building up of fires by the roundhouse help, and handling by the fireman after the engine is turned over to him, good handling by the engineer to prevent slipping and when leaving the initial terminal to prevent turning over the fire and starting clinkers are all items that must be watched if the best results are to be obtained. The entire proposition resolves itself into an engine and fire condition, both of which must be watched by proper officers and exceptions taken to any adverse handling or engine condition that will cause the crew to work under a handicap.

The officer responsible for assignment of power should have a personal knowledge of track and bridge conditions, and this feature is one that should be especially considered on branch line territory.

Another feature that should be given serious consideration in assigning power is where a limited number of superheater engines are available, the conditions being equal, the superheated power should be assigned in territory and on divisions where company coal haul is longest and where company fuel costs the most, thereby decreasing the cost of company coal and increasing the revenue train haul.

Some of the factors contributing to successful assignment of power are a thorough knowledge of the condition and capacity of the power, of the business requirements and cooperation between the departments.

The committee is: P. O. Wood, chairman (St. L. & S. F.); J. D. Heyburn (St. L. & S. F.); D. Meadows (M. C.); F. R. Melcher (C. & N. W.), and W. H. Corbett (M. C.).

DISCUSSION

W. L. Robinson (B. & O.):—The effect of pooling engines may be shown, perhaps, in a general way, by referring to the annual statistics published by the Interstate Commerce Commission. In 1904 a great many railroads followed the system of assigning a regular engine to the crews, while in 1914 most of these railroads were using the pooled system. During that time the average tractive effort of the locomotives increased 38.6 per cent, while the ton-miles per freight locomotive only increased 11.3 per cent. This may be due to the fact that the engines do not give the service under the pooled system that they would where they are assigned. In the annual report of one large railroad, however, the assignment of power is attributed largely to the decrease in operating costs. With an increase of $7,000,000 in business there was a decrease of $347,000 in operating cost and a decrease of $89,000 in fuel cost, which was attributed, by the general manager of that road, to the assignment of power. Regardless of this fact, it is apparent that the management of most roads prefer the pooled system, and we should acknowledge this and make the best of it, and keep the engines in the best possible condition, having the shops ready to make quick and proper repairs.

C. W. Irving (N. & W.):—On one division of the Norfolk & Western there are 10 Mallet locomotives in assigned service. These are always to be found ready for their trips and seldom get to the back shop for repairs more than once in 18 months. The men take an interest in their engines and are usually on them an hour ahead of time to thoroughly examine them. These engines make 3,000 miles per month in freight service, which is considered good for this type.

E. F. Boyle (Sunset Central):—No difficulty is found on the Sunset Central in operating the pool system. Every time an engine reaches a terminal it is given a thorough inspection and the repairs are promptly made. A district of 1,190 miles is operated with three engines with no difficulty whatsoever. Oil engines are used on this road.

F. R. McShane (C. C. C. & St. L.):—The operation of the pooled system can be handled with economy and satisfactorily if the terminal repairs to locomotives are properly made. No matter whether it is the general practice to assign engines or not, it is not possible to keep them assigned at all times. In a special rush of business there are times when they must be pooled.

B. J. Feeney (I. C.):—Four years ago there was a bad congestion on the Illinois Central which was then operating its locomotives under the pooled system. The general manager ordered that the engines be assigned to specific crews against the judgment of many of the road foremen on the road at that time. This was done and two weeks afterward the engine delays were materially decreased. The fuel consumption was decreased and, as it proved later, the cost of maintenance was less.

F. P. Roesch (E. P. & S. W.):—The pool system can be operated satisfactorily if the engines are properly maintained. This requires an organization and a system to do the work properly. With the handling of the army at the border, where we have heavy grades, we had very little difficulty. Locomotives would run through divisions 600 miles long with very few engine failures. We find our cost of handling locomotives at terminals varying between $1.33 and $4.58.

Other speakers on the subject strongly recommended the assignment of power, and numerous interesting cases were mentioned wherein it had been found to be the most desirable thing to do. In one case, on the Baltimore & Ohio, where the power had been assigned, the failures were very small, varying between two and three a month, and the engines made 119 to 121 miles per day. Later when these engines were pooled the failures increased from three to 29, and only 89 to 103 miles per engine per day were made. Under the assigned system the engines were in first class condition while under the pooled system they were not. It was also claimed that the fireman could learn to handle a specific engine and thus make a better fuel performance than if he were given a different engine every day. Various other records were shown wherein the mileage between shoppings and the daily mileage were less under the pooled system than under the assigned system and where more ton miles were hauled.

P. O. Wood (Committee chairman):—The assigning or the pooling of engines would depend a great deal upon local conditions. In either case the engines should be properly maintained. The locomotive inspector is a most valuable man but he can be made absolutely worthless by disregarding his report, and by not making the repairs he recommends. On the Frisco under the pooled system 22,000 miles per engine failure are made on freight engines.

OTHER BUSINESS

W. H. Corbett, (M. C.), presented his report of attendance at the Master Mechanics' Association last June, and also read the paper he was requested to prepare for that association at its convention.

The Committee on Constitution and By-Laws changed the articles requiring that all papers to be presented at the annual convention should be in the hands of the secretary ninety days before the convention. It was also voted that the executive committee confer with representatives of the Air Brake Association and the International Railway Fuel Association regarding their consolidation with the Traveling Engineers' Association.

During the closing exercises W. O. Thompson, secretary of the association since its inception and who was largely responsible for its organization, was presented with a past president's badge, being made an honorary past presidentship. In acknowledging this gift Mr. Thompson stated that since the association has been organized 900 members have served on committees, 181 subjects have been considered and

that the average attendance for the past 15 years has been 300. Professor Louis E. Endsley, of the University of Pittsburgh, was made an honorary member of the association.

The following officers were elected for the ensuing year: President, B. J. Feeney, Ill. Cent.; first vice-president, H. F. Henson, N. & W.; second vice-president, W. L. Robinson, B. & O.; third vice-president, G. A. Kell, G. T.; fourth vice-president, W. E. Preston, Southern; fifth vice-president, L. R. Pyle, M. St. P. & S. S. M.; treasurer, David Meadows, M. C. The following new members were elected to the executive committee: J. Keller, L. V.; J. P. Hurley, Wabash; P. F. Roesch, E. P. & S. W.; E. Hartenstein, C. & A.

Chicago received the vote for the next convention.

PREPAREDNESS AND THE RAILWAYS*

There is a degree of preparedness for national defense the value of which appears to be recognized by all except an eloquent minority. But some of those who clamor loudest for those outward and visible signs of readiness, a strong army and navy, neglect consideration of equally essential fundamental preparations. An army and navy, unsupported by adequate transportation facilities, are merely a bluff.

In the event of war, the transportation of heavy guns is an important factor. The extent of the special transportation facilities absolutely required is probably but little appreciated. The factories where the guns are made and repaired must be located at a distance from the place where their use is required. They must be transported to the firing line. The new 16-in. gun now being developed by the Ordnance Department of the United States army is looked upon with special favor by military authorities. It requires a special car for its transportation. The government does not own such a car, but has obtained the use of one through the courtesy of the Bethlehem Steel Company. The 14-in. gun is transported on a 200,000-lb. flat car with an ordinary flat car serving as a trailer. Only two or three roads, according to the Official Railway Equipment Register for May, 1916, have cars of any class approaching this capacity. The Norfolk & Western has 750 gondolas of 180,000 lb. capacity. The Pennsylvania has about 120 flat cars of 150,000 lb. capacity. Most roads have none over 100,000 lb. capacity.

Some of the requirements in the direction of special rolling-stock equipment are indicated by the weight and dimensions of certain of the larger guns constructed by the United States government for coast defense and general service. These are as follows, on the authority of Lt. Col. Hoffer:

Caliber	Weight	Length	Width
12 in.	132,000 lb.	42 ft.	66.2 in.
14 in.	139,000 lb.	48 ft. 3 in.	66.7 in.
16 in.	284,000 lb.	49 ft. 3 in.	90.5 in.
†16 in.	367,000 lb.	67 ft. 2 in.	88.0 in.

†Figures relating to the new 16-in. gun are taken from the design, the gun itself not having been built at the date of Lt. Col. Hoffer's letter.

All 16-in. guns, therefore, will require for their transportation cars of a capacity of which none have been built except one in possession of the Bethlehem Steel Company. There is only a limited number of cars capable of being used for the transportation of 14-in. guns.

The significance of this lack of equipment can only be brought home by a consideration of the requirements of service in view of the short life of heavy guns under firing conditions. Under ordinarily favorable circumstances in a continuous action, offensive or defensive, from 8 to 10 guns per day would be required to give the service of one. That is, replacement of each gun—the removal of the exhausted gun and the placing of a substitute—would have to go on at the rate of one for every two and a half or three hours. And for this service between each point of action and the distant factory, the special equipment would be required. Contrary to the general supposition that a position strongly fortified with heavy guns can be supported by the use of those guns until the determination of the action, the foregoing statements indicate how short-lived a fortification must be without the requisite transportation facilities.

Adequate facilities are also essential for the transportation of troops and ammunition. Henry Maxim, inventor of explosives, is quoted in a recent book, "War's New Weapons," as saying that "within a circle of 160 miles around Peekskill, N. Y., as the center, will be found 90 per cent of the arms and ammunition works, military stores, smokeless powder works, torpedo and torpedo boat works of the country."

It is about 2,500 miles in an air line from this center to the Pacific Coast and about 1,600 miles to the Rio Grande. Transportation routes are much longer. Either transportation facilities must be adequate to annihilate these distances without delay in the delivery of munitions to the various points where they may be of vital importance, or plants for the manufacture of such munitions should be located at points far in the interior.

The first general requirement is a sufficiency of equipment not only for the conveyance of troops and of ordinary supplies, but of such rolling stock as is adapted for the transport in quantity of the heavier items of military outfitting, in addition to that which is necessary to carry on ordinary transportation service. The ordinary demands of transportation service cannot be left out of the account. In many respects the supply of rolling stock equipment fails to be adequate in times of peace. The special demands created by a condition of warfare would magnify this deficiency, at least locally. What would amount to a considerable surplus of equipment under ordinary traffic conditions would be quickly wiped out if the railways should be called upon to perform their essential functions as a part of a system of defense. To move a field army would require: 2,115 passenger cars; 385 baggage cars; 1,055 box cars; 1,899 stock cars; 775 flat cars; total, 6,229 cars, which make about 366 trains, and require this number of locomotives.

Of fully as great importance as an adequate supply of equipment is the requirement that all roadway and track facilities be put in proper condition. This point may be specially emphasized in view of a too-well-founded impression that on many lines during the last two or three years of business depression maintenance of way has been somewhat neglected.

But the railways cannot be depended upon even to the limit of their present efficiency unless means can be provided for their protection against defection within their own organization. A short time ago, when trouble from any one of three or more foreign sources was threatening, four of the most powerful organizations of labor concerned in railway operation threatened to tie up every mile of railway in the United States unless certain extreme demands for increased wages were granted. These employees know, because they are part of it, the vital function the railways perform in the commercial prosperity of the country. They know the difficulties through which the railway industry has been passing in the last few years and they know that it is impossible for the railways to meet their demands except there shall be granted measures of relief which must come, if at all, from sources entirely beyond the control of the railways themselves. They know, also, that at a crisis in national affairs such as may materialize at any moment, a strike by operating railway employees would be an act of treachery to the nation to which they belong of which there is no parallel in the civil or military history of any country.

In case of actual hostilities all employees should be placed under military control, and any failure to stay at work and perform their duties should be made punishable just as the failure of a soldier to perform his duties is punishable.

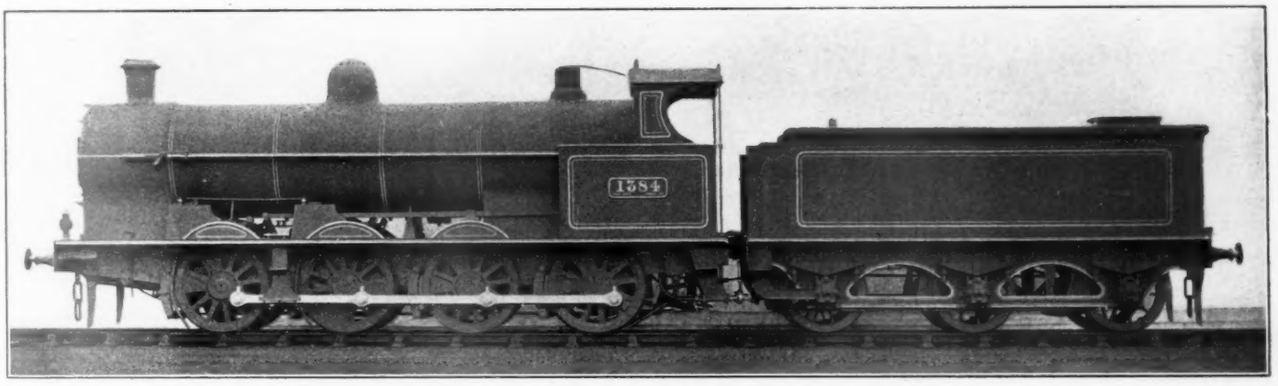
*Abstract of a paper presented by W. L. Park, vice-president, Illinois Central, at the September meeting of the Western Railway Club.

Modern British Goods Locomotives

The 2-8-0 and 4-6-0 Types Are the Largest Employed; 0-8-0 and 2-6-0 Types Still Frequently Used

BY E. C. POULTNEY, M. Am. Soc. M. E.; A. M. I. M. E.

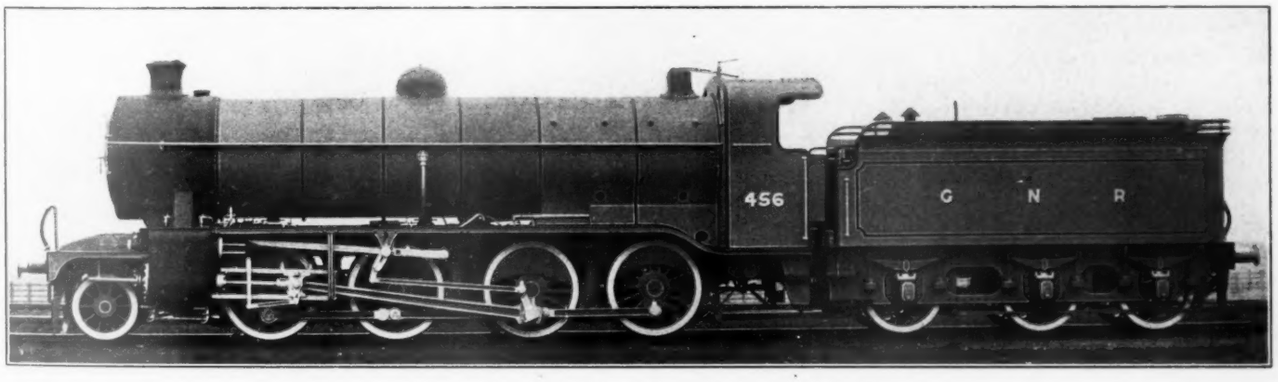
FOR many years the main line goods and mineral traffic of British railways was conducted entirely by engines of the 0-6-0 or six-coupled type, having wheels about 4 ft. 6 in. or 5 ft. in diameter, according to the class of traffic they were required to handle. Some railways have recently built superheated engines of this type and when thus equipped, engines of considerable power can be obtained. However, an actual heating surface of 1,500 sq. ft. to 1,600 sq. ft. and in the case of superheated engines, an equivalent heating surface of 1,700 sq. ft. marks the limit in the boiler capacity obtainable with engines of this type, owing to the allowable weight that can be placed on three axles.



London & North Western Superheated Goods Locomotive

Demands for increased hauling power have led to the development of the 0-6-0 engine in two directions. By the addition of another coupled axle, the eight-coupled or 0-8-0 type is attained, thus increasing the weight available for adhesion and rendering an increase in tractive effort obtainable and at the same time making it possible, in the case of engines using saturated steam, to provide boiler power up to about 2,000 sq. ft. of heating surface, or in the case of superheater engines, an equivalent heating surface of 2,300 sq. ft. The other direction in which development has taken place is by adding either a leading "pony" or a four-wheeler truck or "bogie" and thus obtaining the 2-6-0 and 4-6-0 types respectively. The advantage of both is, in fact, that an extension of the boiler heating surfaces is obtainable, making it possible to realize a greater percentage of the available tractive effort and higher sustained speeds. Recently, the 0-8-0 type has been further developed to the 2-8-0 type, the additional carrying wheels enabling an increase in boiler capacity to be obtained. A study of the table of dimensions will reveal the fact that in some cases the total weight of 0-8-0 and 2-8-0 types are very similar. This is, of course, due to the fact that the allowable weight per axle varies on different roads.

Superheating is now in general use and excellent results are being obtained. The application of a superheater is in reality equal to an extension of the evaporative heating surfaces and any addition to heating surface is attended by either a decrease in fuel consumption for the same power or by an increase in power for the same fuel consumption. In this connection, it is interesting to draw attention to the dimensions given of some large 4-6-0 engines recently put into service on the London & South Western, both classes are alike in all particulars, except that some use saturated steam, the boilers having a total evaporative heating surface of 2,192 sq. ft. and the superheater equipped engines, having exactly the same sized boilers except so far as the superheater modifies the disposition of the heating surfaces, have a total equivalent heating surface of 2,517 sq. ft., represent-



Great Northern Eight-Coupled Goods Locomotive

ing a gain of 14.8 per cent in boiler power. The efficiency of superheated engines is, however, more readily affected by the kind of service on which the engine so fitted is employed, than is the case with engines using saturated steam. This is due to the fact that considerable loss in superheat is experienced if frequent stops are made, for reasons easily understood.

The abolishing of dampers or the fitting of improved means of operating them has, however, improved the action of superheated engines on intermittent service and made it possible to realize results comparing favorably with engines run under the best conditions, namely on long continuous runs such as obtain in express passenger or through goods service. The Midland Railway have introduced an ingenious arrangement for operating the damper gear in connection with the superheater equipment they use, the device being arranged so that the dampers may automatically open or close according to whether the "regulator" or throttle valve is open or shut, or they may remain permanently open independent of the position of the regulator. Under the latter conditions, however, the arrangement is such that should the steam blower be put on, the dampers automatically close and open again when the blower is stopped. The first mentioned conditions are used when working trains making long continuous runs and the second when operating trains which make frequent stops. This device makes superheated engines efficient on all kinds of service, the loss in superheat being reduced to a minimum when the engines are operating trains making frequent stops.

Another idea designed with the object of reducing the loss of superheat is a special form of header in use on the Hull & Barnsley on goods locomotives. The design of the header, in which is incorporated the regulator valve, is such that boiler steam is always in the superheater elements and header, the regulator valve simply controlling the supply of steam between the header and the cylinders; thus the pressure of steam in the superheater at all times prevents the elements from becoming damaged through overheating. Some designers use a by-pass arrangement to connect the two ends of the cylinders when the engine is running without steam in order to do away with the pumping action of the pistons; this is, however, by no means general, most designers simply fitting automatic air valves to the steam chests. The Midland use a by-pass pipe connecting the ends of the cylinders and fitted in the centre of its length with a double beat valve operated by a small steam piston mounted on the valve stem. The underside of this small piston is connected by means of a small pipe with the steam supply to the main cylinders so that when steam is on the valves are kept on their seats, thus cutting off connection between the ends of the cylinders, and when steam is shut off, the valves simply fall from their seats thus establishing connection between the ends of the cylinders.

Piston slide valves giving inside admission are used as a rule where superheated steam is employed and Walschaert valve motion is coming into favor on the Great Northern, while the London & North Western and the Lancashire & Yorkshire both use Joy gear. The usual form of valve motion on other lines is the ordinary link motion and the wheel and screw is generally favored for operating the reversing gear. Engines of the 2-6-0 and 4-6-0 types are usually fitted with the necessary apparatus for working the continuous brake in use on the particular railway on which they are employed. This enables the engines to run passenger trains if desired and also heavy trains of perishable goods which are composed of "fitted" stock and are run at passenger train speed. Goods and mineral trains are not as a rule equipped with any form of continuous brake and it has been the practice for many years past to fit the locomotives used entirely for goods traffic with powerful steam brakes operating on the engine and tender. This is still very general practice. Exceptions are, however, to be found, in which cases the automatic vacuum or Westinghouse brake

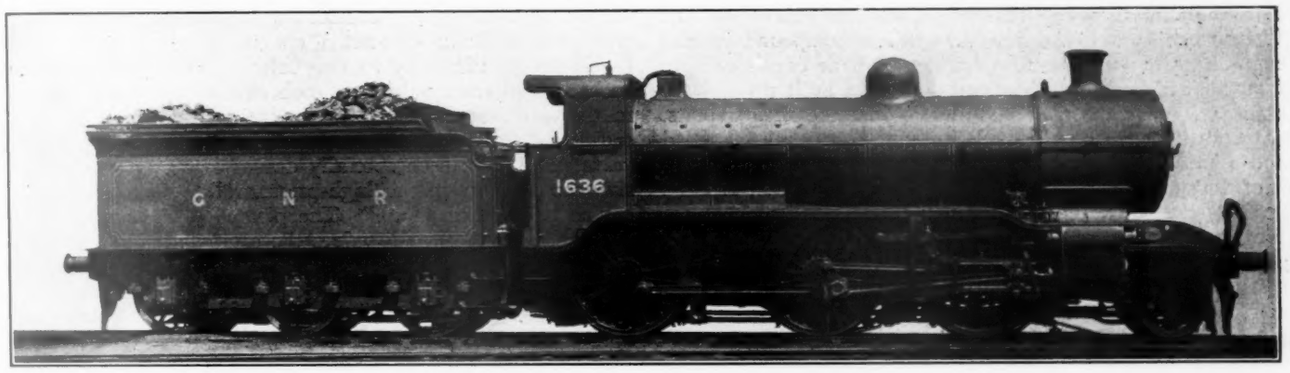
Dimensions and Proportions of Modern British Locomotives for Goods and Mineral Traffic

Railway	London & No. Western		Great Northern		Great Central		Great Western		Lancashire & Yorkshire		Midland	Glasgow & So. West'n	North Eastern	Somerset & Dorset	Hull & Barnsley	Caledonian	London & So. Western	
Type	0-8-0	4-6-0	2-8-0	2-6-0	2-8-0	4-6-0	2-8-0	2-6-0	0-8-0	0-8-0	0-6-0	2-6-0	0-8-0	2-8-0	0-6-0	2-6-0	4-6-0	4-6-0
Cylinders, number	2	2	2	2	2	2	2	2	2	4	2	2	2	2	2	2	2	2
Cylinders, size, in.	20½ by 24	19 by 26	21 by 28	20 by 26	21 by 26	21½ by 26	18½ by 30	18½ by 30	20 by 26	2 H. P.—15½ by 26 2 L. P.—22 by 26	20 by 26	19½ by 26	20 by 26	21 by 28	19 by 26	19½ by 26	21 by 28	21 by 28
Coupled wheels, diameter	4 ft. 5½ in.	5 ft. 3 in.	4 ft. 8 in.	5 ft. 8 in.	4 ft. 8 in.	5 ft. 7 in.	4 ft. 7½ in.	5 ft. 8 in.	4 ft. 6 in.	4 ft. 6 in.	5 ft. 3 in.	5 ft. 4 ft. 4 in.	4 ft. 7½ in.	4 ft. 7½ in.	5 ft.	5 ft. 9 in.	6 ft.	6 ft.
Boiler pressure	160	175	170	170	170	180	225	200	180	180	160	180	160	190	170	170	180	180
Heating surface, tubes, sq. ft.	1,625.7	1,840.5	1,922	1,523	1,538	2,210	1,686.0	1,349.0	1,767.0	1,767.0	1,045	1,344	1,226.2	1,170	968	1,439	2,025	1,759
Heating surface, firebox, sq. ft.	146.7	144.3	162	144	153	167	155.0	128.7	147.0	147.0	125	147	144.0	151	132	128	167	167
Heating surface, total, sq. ft.	1,772.4	1,984.8	2,084	1,667	1,691	2,377	1,841	1,477.7	1,914	1,914	1,170	1,491	1,370.2	1,321	1,100	1,567	2,192	1,926
Heating surface, superheater, sq. ft.	378.6	...	570	403	318	440	287.0	212.5	...	...	313	211	344.8	360	217	403	...	394
Total equivalent* heating surface	2,340.0	...	2,939	2,204	2,168	3,037	2,371.0	1,846.4	...	...	1,639	1,807	2,187	1,861	1,425	2,161	...	2,517
Grate area, sq. ft.	23.6	25.0	27.0	24	26.0	26	27.0	20.5	23.05	23.05	21.1	26.25	23.0	28.4	19.6	21.0	30.0	30.0
Tractive effort, lb.†	25,700	22,196	31,750	22,600	28,700	28,318	35,200	22,220	25,763	25,763	22,490	23,700	24,600	36,360	22,600	20,600	26,200	26,200
Cylinder volume per mile, cu. ft.	6,705	6,900	8,070	5,620	7,490	6,540	6,770	5,530	6,866	6,866	6,070	6,050	7,420	7,997	5,820	5,660	6,160	6,160
Weight on coupled axles, lb.	134,400	99,000	150,080	119,504	...	124,320	138,660	120,064	137,340	137,340	109,984	122,784	147,616	125,496	114,672	115,360	131,264	131,264
Weight of engine only, in working trim, lb.	134,400	141,120	170,688	142,576	161,280	...	152,996	141,120	137,340	137,340	109,984	139,000	147,616	135,030	114,672	153,440	177,960	177,960
Superheating surface, per cent of the total heating surface	17.6	.....	21.1	19.3	15.3	15.6	13.4	12.5	.....	.....	21.1	12.38	28.6	21.4	16.5	20.6	....	12.8
Cylinder volume per mile ÷ heating surface (actual)‡	3.21	3.38	3.04	2.74	3.72	2.28	3.18	3.27	3.51	5.65	4.1	3.55	3.87	4.71	4.23	2.89	2.82	2.66
Cylinder volume per mile ÷ equivalent heating surface*	2.95	...	2.74	2.58	3.45	2.15	2.86	3.0	...	...	3.71	3.35	3.39	4.29	4.07	2.62	...	2.43
Cylinder vol. per mile ÷ grate area.	292	268	299	238	288	250	247	319	297	468	288	231	322	281	297	270	205	205
Weight on coupled axles ÷ tractive effort	5.16	4.46	5.73	5.28	.....	4.4	3.9	5.4	5.35	.....	4.85	5.17	6.0	3.36	5.07	5.6	5.0	5.0
Total engine weight ÷ heating surface (actual)‡	61.6	71.2	64.3	67.7	80.2	.....	71.7	83.5	71.7	71.7	73.5	77.8	77.0	80.3	82.0	78.3	81.1	76.6
Total engine weight ÷ equivalent heating surface	56.6	.....	58.1	64.0	70.6	.....	64.4	76.5	.....	.....	66.5	74.2	67.5	72.5	80.04	71.0	....	70.3
Weight on coupled axles, per cent of the total engine weight	100.0	70.0	88.0	84.0	.....	.....	90.06	85.0	100.0	100.0	100.0	87.2	100.0	93.0	100.0	75.5	73.8	73.8

* The equivalent heating surface is estimated by adding a value equal to 1.5 times the superheating surface to the total evaporative surface.
† Mean effective pressure 85 per cent of boiler pressure. ‡ Actual heating surface = total evaporating heating surface + the superheating surface.

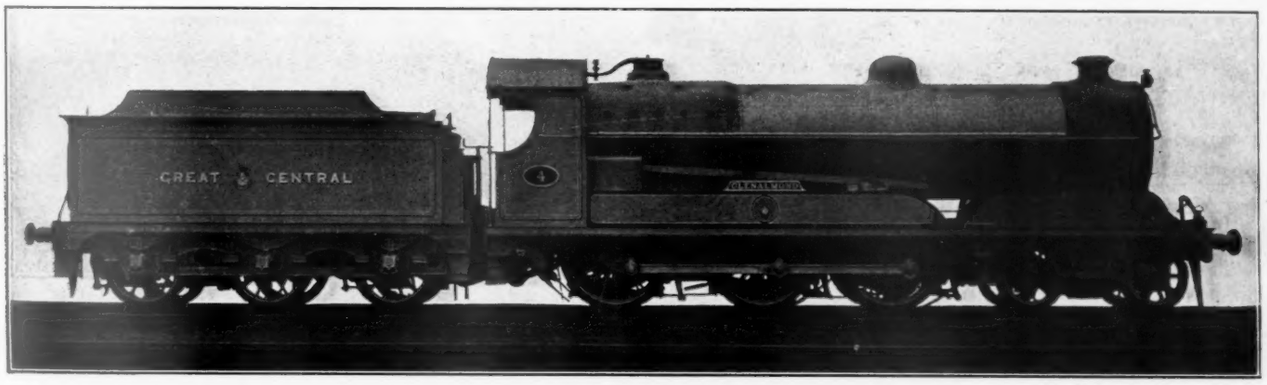
are used in lieu of a steam brake, or sometimes a steam brake is used which is automatically brought into action when the vacuum brake is applied on the trains or independently in the case of trains composed of "non fitted" stock. Tenders are in general interchangeable with those used with other classes of engines on the same railway.

The first eight-coupled engine in Britain for main line service was built at Crewe in 1892 by the late F. W. Webb, for working heavy coal trains on the London & North Western. This engine had inside cylinders 19½ in. by 24 in., coupled wheels 4 ft. 5 in. diameter, and had a boiler carrying high-pressure cylinders were 16 in. by 24 in. and the two low-pressurs cylinders placed between the frames were 20½ in. by 24 in. Piston slide valves were introduced to distribute the steam in the high-pressure cylinders and Joy valve motion applied to the inside gear worked the flat valves of the low-pressure cylinders direct and the high-pressure valves through rocking levers, two sets of valve gear thus operating the four valves. Adjacent cranks on each side of the engine were on opposite centers, each pair being at 90 deg. The weight of the engine only, in working trim, was 119,840 lb. Large numbers of these engines were built;



Great Northern Six-Coupled Goods Locomotive

a steam pressure of 160 lb. which contained 1,245 sq. ft. of heating surface. The total engine weight in working order was 104,792 lb. This engine was followed in 1893 by another similar in design but compounded on F. W. Webb's three-cylinder system. These two engines were run in competition with the result that subsequent engines were all compounds. The compound engines had two outside high-pressure cylinders 15 in. by 24 in. and one inside low-pressure cylinder 30 in. by 24 in., all driving on to the second coupled axle. The high-pressure crank pins were at 90 deg. with each other and the central crank made 135 deg. with each of the high-pressure cranks. The boiler contained 1,489 sq. ft. of heating surface, the increase being in the tube surface. The some were provided with two-wheeled pony trucks at the leading end, thus becoming 2-8-0 or Consolidation type engines, the first in Britain. The coupled wheels of each class were the same diameter and had cast iron centers, a practice unique in main line service, and this material is still used for 0-8-0 engines built at Crewe. All the compound engines have now been converted into simple engines; in the case of the four-cylinder engines the low-pressure cylinders have been retained as simple expansion cylinders and the working steam pressure reduced from 200 lb. to 165 lb. The engine illustrated is one of a new type designed by C. J. Bowen-Cooke, the chief mechanical engineer. It is equipped with a Schmidt superheater and when compared with similar engines



Great Central Six-Coupled Express Goods Engine

coupled wheels were 4 ft. 5 in. diameter and the engine weighed 110,320 lb. in working trim. In these engines, considerable numbers of which were built, the steam pressure was increased to 175 lb.

Some years later after F. W. Webb had commenced to build his four-cylinder compound express engines, he applied his four-cylinder system to the eight-coupled goods engines and the first engine turned out was built at Crewe in 1901. These were similar to the three-cylinder engines, but the boilers were larger, the total heating surface being increased to 1,753 sq. ft., and the steam pressure was raised to 200 lb. The using saturated steam doing equal work, this type has shown a saving of 25 per cent in coal consumption. The engines have inside cylinders and piston valves worked by Joy motion. The wheels are 4 ft. 5½ in. diameter with new tires. A steam brake is fitted which operates on the engine and tender. The tender is of standard design and has capacity for 7 tons of coal and 3,000 gallons of water. It is fitted with a water scoop and weighs 83,000 lb. loaded.

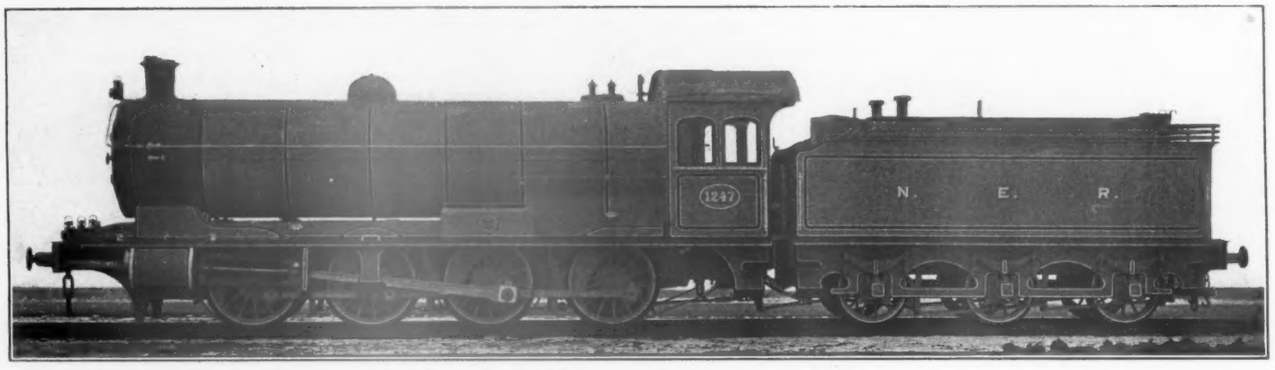
The 4-6-0 engines, particulars of which are given in the table of dimensions, were built for main line fast goods traffic on the London & North Western from the designs of the late

G. Whale, when chief mechanical engineer. In design these engines resemble closely Mr. Whale's 4-6-0 express engines introduced in 1906, the main difference being the diameter of the coupled wheels which in the goods engine is 5 ft. 3 in. diameter, and in the case of the passenger engine, 6 ft. 3 in. The cylinders are inside, driving on to the leading coupled axle, and the distribution of steam is effected by flat semi-balanced valves working in steam chests on the top of the cylinders and operated by Joy valve gear. The leading end of the engine is carried on a four-wheeled bogie. The London & North Western bogie differs from those most used in that the lateral movement takes place in a radial path similar to a radial axle box. This bogie was introduced by Mr. Webb when he designed his four-cylinder compound express engines which were the first engines built at Crewe to have four-wheeled bogies. The crank axles are built up and the crank webs are extended in order to form balance weights. Apparatus for working the automatic vacuum brake is fitted and a steam brake operates on the engine and tender, which is of the standard type. Previous to the introduction of these engines, the express goods service on the London & North Western was largely worked by Mr. Webb's 18-in. 0-6-0 goods engines having 5 ft. wheels. These engines are of historic interest inasmuch as they were the first locomotives ever fitted with Joy system of valve motion and when first introduced in 1880 they attracted considerable attention.

The Lancashire & Yorkshire employ eight coupled engines for hauling the heavy goods traffic they have to contend with on a road which is difficult to work, and at present four classes are in service: three having simple expansion cylinders and one compound having four cylinders. The simple engines differ from each other in the design and size of the different boilers used. The first engines put into service had inside cylinders 20 in. by 26 in. and boilers with Belpair fire boxes providing 1,914 sq. ft. of heating surface. They weighed in working order 137,752 lb. These engines were followed by a number of similar locomotives having exactly the same sized cylinders and wheels, but they were fitted with a new type of boiler having a cylindrical inside and outside fire box, the inside box being corrugated and made of steel, except the tube sheet which is made of copper. These boilers have 1,890 sq. ft. of heating surface and the weight in working order, engine only, is 129,680 lb.

The next engines to be built were the compounds already mentioned. G. Hughes, the locomotive engineer, decided to apply the compound principle to goods engines rather than passenger locomotives, his contention being that they are more suitable for compounding as the usual cut-off is much later in simple expansion goods engines than in simple expansion passenger engines, also the piston speeds attained are very much less than those realized in express engines, thus making it more possible to effect a saving in steam consumption by a reduction of the losses due to cylinder condensation as well as by increasing the number of times the steam is expanded. The compound engines have the same size Belpair boiler working at the same steam pressure as the simple expansion goods engines. Four cylinders are used, two high-pressure outside the frames driving on the third coupled axle and two low-pressure inside driving on to the second axle, placed transversely in line with the outside cylinders. The inside and outside cranks on each side of the engine are on opposite centers and each pair makes an angle of 90 deg. with the other. Flat semi-balanced valves distribute the steam in the low-pressure cylinders and the low-pressure exhaust takes place through the backs of the valves directly into the blast pipe; thus a free exhaust is attained. Piston valves are used for the high-pressure cylinders. Joy valve gear is used and is applied to the inside motion, connection being made to the high-pressure valves by rocking levers. The arrangement is such that adjacent valves on each side of the engine travel in the same direction, an arrangement made necessary because the piston valves have inside admission. The piston valves used have been specially designed to eliminate excessive compression in the high-pressure cylinders due to the engine being "linked up." The piston valve packing rings are fitted with six small valves the construction of which is such that the pressure in the receiver holds them on their seats against the pressure in the cylinder, providing the latter does not rise above the working pressure. This is effected by designing the valves in such a way that the area exposed to the receiver pressure is greater than that exposed to the pressure in the high-pressure cylinders. Starting is effected by supplying steam direct from the boiler to the low-pressure steam chests. This is effected by two sliding valves working in a small rectangular valve box cast integral with the low-pressure cylinders and valve chests. These valves work over two ports connected respectively with the right and left low-pressure steam chests, a pipe conveying steam from the main steam pipe to the small valve chest. The starting valves are controlled by the position of the reversing gear, being connected to a lever on the reversing shaft. On the main regulator being opened steam is admitted to the low-pressure and high-pressure steam chests at the same time, the high-pressure pistons by that means being placed in equilibrium, and starting is effected by the low-pressure pistons only. When, however, the engine is "linked up" the small valve covers the ports leading to the low-pressure valve chests and the engine is compounded. This device is very simple and is so arranged that the low-pressure cylinders can only be supplied with steam direct from the main steam pipe when the engine is in either full forward or full back gear.

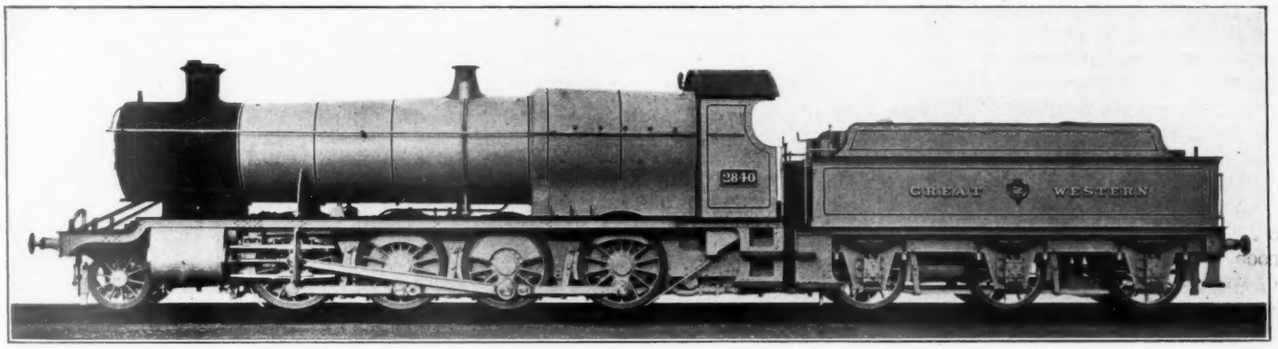
The two classes of engines, particulars of which are given in the table of dimensions, have been the subject of exhaustive tests during which 11 simple engines and 11 compound engines ran 472,000 and 442,000 engine miles respectively, the percentage of train miles being in the case of the simple engine 63.6 and in the case of the compound 68.3, the average loads behind the tender being 465 tons. After making



Superheated Goods Locomotive, North Eastern Railway

deduction of 1½ cwts. of coal per hour for fuel used during detentions, the results showed that the coal consumption of the compound was .185 lb. per ton mile against .205 used by the simple engine. A very complete statement as to the working of these and of superheated engines on the Lancashire & Yorkshire will be found in the transactions of the Institute of Mechanical Engineers for 1910.

Latterly some large simple expansion superheated engines have been put into service, which, in general, are similar to the earlier simple engines. They have, however, considerably larger boilers having a total evaporative heating surface of 1,963 sq. ft. and superheaters giving 396 sq. ft. of heating surface, the whole representing a total equivalent heating surface of 2,557 sq. ft. The cylinders are between the frames and are 21½ in. by 26 in. and the steam pressure is 180 lb.



Great Western Eight-Coupled Goods Locomotive

The eight-coupled wheels are 4 ft. 6 in. diameter and in common with the other Lancashire & Yorkshire engines, are fitted with Joy valve motion. All the four classes of eight-coupled engines are accompanied by eight-wheel tenders but the wheels are not in bogie frames. These tenders have capacity for 3,600 gallons of water and 5 tons of coal. The vacuum brake is fitted to the engines and tenders.

The heavy coal traffic on the Great Northern has been conducted for some time by engines of the 0-8-0 type, the first design introduced having inside cylinders 19¾ in. by 24 in. with flat semi-balanced valves working in steam chests on the top of the cylinders and operated by the ordinary link motion through rockers. The boilers have 1,438 sq. ft. of heating surface and the area of the grate is 24.5 sq. ft. The working steam pressure is 170 lb. The coupled wheels are 4 ft. 8 in. diameter. Recently, some of these engines have been rebuilt and equipped with Schmidt superheaters.

The latest type of engine introduced for heavy main line coal and other traffic is of the 2-8-0 type, the additional wheels being made necessary by the increased weight of the engine due to the large boiler. The cylinders are in this case outside the frames and piston valves worked by Walschaert motion are used. Some of these engines are fitted with steam pumps for supplying the boiler feed water and also with feed water heaters. These engines are remarkable for their boiler capacity, the amount of heating surface allowed when compared with the cylinder capacity being very generous.

The 2-6-0 engine illustrated is a development of a smaller class of the same type introduced in 1912 having boilers fitted with superheaters and containing a total heating surface of 1,420 sq. ft. In other respects the two classes are very similar but the present engines are more powerful, by reason of the fact that they have a total heating surface of 2,080 sq. ft. The pony trucks of the 2-8-0 and 2-6-0 types have been designed to equalize the weight when passing round curves, this being obtained by top and bottom bolsters each carried on swing links.

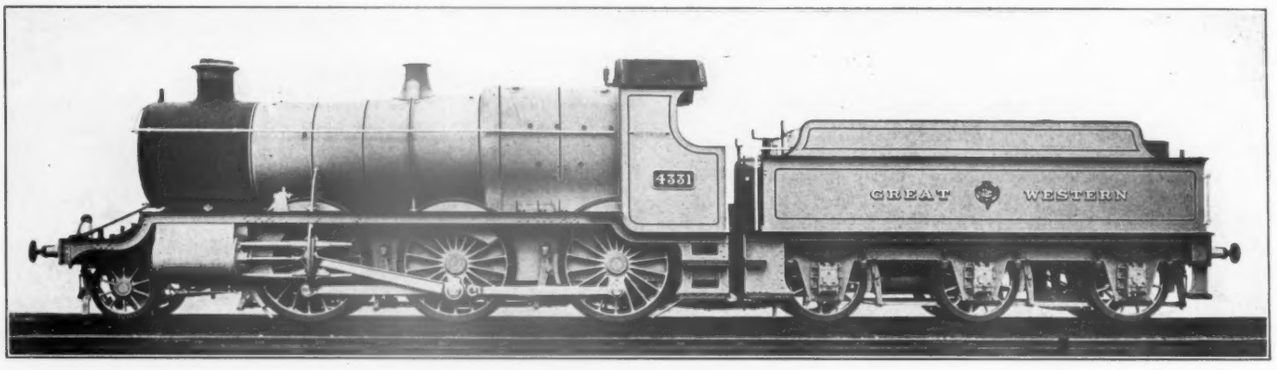
The Great Northern was one of the first railways to fit superheaters, the type used being the Schmidt. Recently, however, a new type of flue tube superheater has been designed by the locomotive engineer, H. N. Gresley, called the twin-tube superheater. Two headers are used, one above in the usual position for saturated steam and another lower in the smoke box for the superheated steam, the two being connected by the superheating elements. Each element has four lengths of tube, but instead of all four lengths of tube being in one flue tube, as is the case in the Schmidt system, two lengths, that is one loop, are in one flue and the other two in the flue immediately below. The claims made for this arrangement are that smaller flue tubes may be used, thus the bridge pieces in the tube sheets are wider, also all elements are interchangeable and each can be taken out without disturbing any of the others, further, compared with a Schmidt superheater of the same amount of heating surface, this superheater permits an increase in the evaporative surface of 10 per cent. A large air valve is fitted to the saturated steam header and when steam is shut off, this valve opens and allows air to enter the elements, thus preventing them from becoming damaged by overheating.

The Great Central Railway use 2-8-0 engines for hauling the heaviest traffic they have to handle. These engines were preceded by engines of the 0-8-0 type which were introduced some years ago. The newer engines in general present no unusual features. They have outside cylinders driving on the third coupled axle, piston valves and the ordinary form of link motion. The boilers have Belpair fire boxes and flue tube superheaters. The fast goods traffic is conducted by some very large 4-6-0 engines which are certainly the most powerful of their type in the country. The boilers, cylinders and motion are the same as used in the large 4-6-0 express engines introduced previously and, like all Great Central engines, are fitted with the Robinson superheater. These engines are fitted with the apparatus for working the automatic vacuum brake and a steam brake is used on the engine and tender.

The most recent class of eight coupled goods engine used on the North Eastern Railway, is illustrated by the photograph for which the writer is indebted to V. L. Raven, the chief mechanical engineer. The general design follows closely some engines of the same type introduced by W. Worsdell in 1901. The present engines are, however, fitted with larger boilers equipped with flue tube superheaters. Piston valves operated by the ordinary form of link motion are used and a steam brake is fitted to the engine and tender, the arrangement being such that one brake cylinder on the engine applies a brake block to each wheel on the engine, and to each wheel on the tender. The boiler is supported at the smoke box end by a cast saddle and it may be pointed out that this method of front end support has, of late years, found considerable favor in England. Two pop safety valves are used instead of the Ramsbottom type usually employed in British practice. The tender is of the six-wheeled type and is of considerable size, having capacity for 3,940 gallons of water and 5 tons of coal. Its weight loaded is 92,288 lb. and empty 44,800. The engines present a particularly neat

appearance in common with general North Eastern practice.

The writer is indebted to G. J. Churchward, locomotive superintendent of the Great Western Railway, for the photographs and particulars of the two Great Western engines illustrated. The 2-8-0 engine represents a class designed to conduct the heaviest main line traffic and is an engine of considerable power. The 2-6-0 engine is one of a class introduced for hauling fast goods trains, and like all modern Great Western engines, is fitted with a flue tube superheater designed by Mr. Churchward and known as the Swindon superheater. The outside cylinders of both engines have piston valves worked by the ordinary type of link motion. An automatic air valve is fitted to the steam chests and the cylinder covers are fitted with spring loaded water relief valves. Both engines are fitted with the Swindon top feed arrangement whereby the feed water is introduced into the steam space of the boiler through non-return valves fitted on the safty valve mounting, the pipes to which are well shown in the photographs. It will also be noticed that the connecting rod big ends are of the solid bush pattern, a practice universal in the case of all outside cylindered engines built at Swindon. Both engines have the standard type of six-wheel tender which carries 3,500 gallons of water and about 5 tons of coal. The automatic vacuum brake is fitted to the engine and tender and the latter is fitted with a water scoop. The Swindon type of boiler is clearly shown in the photograph which illustrates the standard No. 1 boiler as fitted to the 4-6-0 express engines and the 2-8-0 locomotives. It will be seen that the boilers are without steam domes, the steam being collected by a long pipe running through the steam space in the boiler barrel and the regulator valve is placed in the smoke box above the superheater header. Another feature of Great Western practice is the method of supporting the boiler at the smoke box end, this being done by means of a cast saddle similar to American practice. The expansion bracket supporting the fire box which slides on the top of the frame plates is clearly shown in the photograph.



Express Goods Locomotive, Great Western

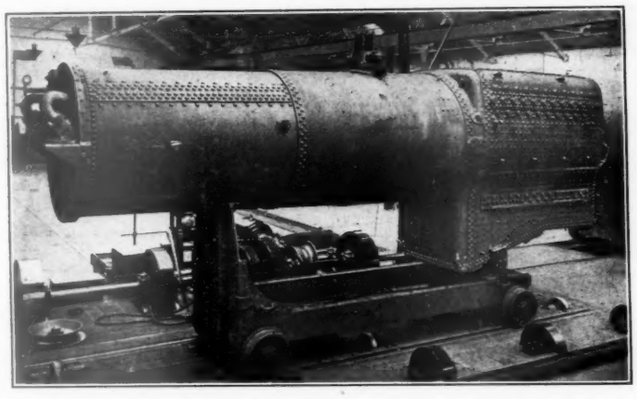
The 2-8-0 engine, particulars of which are tabulated, has been put into service on the Somerset & Dorset for working heavy trains over a difficult road. The engines were built at the Derby Shops of the Midland Railway from the designs of H. Fowler, locomotive engineer of the Midland, which provides the locomotive power for the Somerset & Dorset. The engines have outside cylinders and piston valves worked by Walschaert gear, and reversing by a steam gear. The boilers have Belpair fire boxes and Schmidt superheaters and Mr. Fowler's cylinder by-pass arrangement and damper control gear are fitted. The cylinders drive on the third coupled axle. A steam brake operates on the engine and tender and the pony truck wheels have brake blocks.

The Hull & Barnsley employ engines of the 0-6-0 type, dimensions of which are enumerated, on main line goods service. These engines have "inside" cylinders, the valves instead of being of the cylindrical pattern, generally employed where superheated steam is used, are flat semi-balanced valves, special arrangements being made by means of oil passages drilled in the valve chest valve faces for efficiently lubricating the slide valves. These oil passages are connected by means of suitable piping to a mechanical lubricator driven from the low-pressure rocking lever at the point where it joins the valve spindle. It may here be mentioned that mechanical lubricators giving a forced oil feed to both pistons and valves is usual practice in Britain where high degree superheated steam is employed. These engines were fully illustrated in Engineering of July 2, 1915, and may be said to be characteristic of British practice in the design of inside cylinders 0-6-0 engines, of which large numbers are at work on all railways, though in general they are not superheated.

In 1914 some powerful outside cylindered 4-6-0 type engines were put into service on the London & South Western for fast goods and heavy passenger traffic, and are what are generally known as "mixed traffic engines." At first, 10 of these engines were built, two using saturated and eight, superheated steam; four of the latter having Schmidt superheaters and four having the Robinson equipment. In other respects, the engines are identical. The dimensions given in the table give particulars of the saturated steam engines in comparison with those fitted with the Schmidt superheater. Walschaert valve motion is used and the valves are of the piston type. The boilers of these engines are of the usual type, having round topped fire box wrappers and the roof of the inside fire box is supported by direct stays in such a way that each stay will allow of the upward movement of the inside box. This is arranged for by suspending the stays from forgings in the form of two inverted tees joined together, the vertical members being pinned to bridge section pieces riveted round the inside of the wrapper sheet. Each double tee section has three stays—one passing through each end and one through the center between the suspension members. The stays are screwed into the inside fire-box crown and pass through the tee pieces a working fit and are held by two nuts on the top side of the tees. In this way, they take the load but allow the inside box to rise when it expands, due to the heat when steam is being raised. The end stays, that is, those close to the tube sheet and back sheet, are suspended from the pieces which support two stays each in much the same way to that shown in the *Railway Mechanical Engineer* for August, 1916, when the Great Central 4-4-0 express engines were illustrated and described.

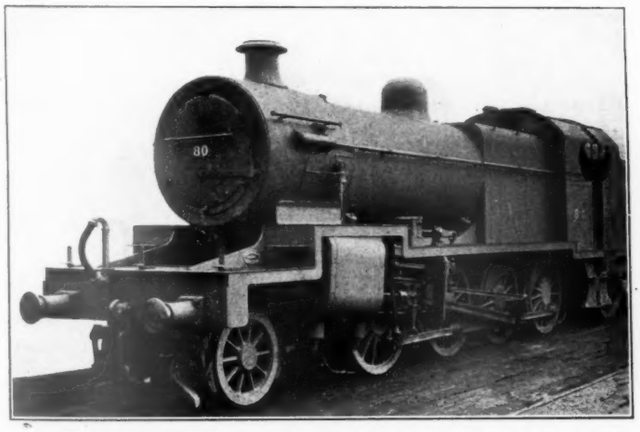
The engines have large eight-wheeled double bogie tenders, having space for 5 tons of coal and a tank capacity of 5,200 gallons and both the engine and tender are fitted with the automatic vacuum brake. These tenders are heavy, weighing 128,800 lb. when loaded. The total weight of the engine and tender in working trim is 306,760 lb. or 136.6 English tons, being the heaviest class of engine and tender running in the country.

Just previous to his retirement, J. F. McIntosh built, at the St. Rollox Works of the Caledonian Railway, some large 4-6-0 inside cylindered engines designed for dealing with fast goods traffic. In general, these engines follow the usual neat design of Caledonian engines, but an innovation was made in the design of the cab which has side windows similar to those used on the North Eastern and to a limited extent on the Great Eastern lines. These engines are fitted with Robinson flue tube superheaters and the cylinders are between the frames and have their steam chests on the top. Piston valves are used driven by the ordinary link motion by



Standard Boiler for 4-6-0 and 2-8-0 Type Locomotives, Great Western

means of rockers. The leading coupled axle is the crank axle and it is of the built-up description. Steam reversing gear is fitted. The boiler is of the ordinary type, having a round topped outside fire box and direct roof stays, those in front close to the tube sheet being so arranged as to permit of the upward expansion of the inside fire box. Four 4-inch safety valves are provided in common with all Caledonian engines of the larger type. The connecting rods have big ends of an unusual pattern, the ends of which are forked and the brasses are held in position by means of a cap held by two large bolts. This type of big end has been in use some



Somerset & Dorset Joint Railway Eight-Coupled Tender Goods Engine

years on the Caledonian and is also much used on the Lancashire & Yorkshire and other lines. In general, however, the strap form with gib and cotter adjustment is still much used and may safely be said to be the type most favored.

Mention should also be made of some very powerful 0-8-0 engines introduced for service on the Caledonian Railway some years ago by J. F. McIntosh when locomotive engineer. These engines have cylinders inside, 21 in. by 26 in., coupled wheels 4 ft. 6 in. diameter, and boilers working at a steam pressure of 175 lb. containing 2,500 sq. ft. of heating surface and having a grate area of 23 sq. ft. The total weight, engine only, is 140,000 lb.

It should be noted that weights expressed in tons and capacities in gallons in this article are British measure in all instances. Engine weights have been reduced to pounds, this being in harmony with American practice.

The table gives the principal particulars relating to 18 different engines put into service during the last decade. It will be seen that a considerable range of power is covered by the engines mentioned, as the equivalent heating surfaces vary from 1,425 sq. ft. in the case of the Hull & Barnsley 0-6-0 engine, to 3,037 sq. ft. in the case of the Great Central 4-6-0 engine. The locomotives mentioned have been selected for treatment in the belief that they are representative of modern British practice and although additional engines might have been noticed, they would be, in general, similar both in design and construction to those described.

THE KIESEL TRAIN RESISTANCE FORMULAS

BY A. J. WOOD
Assistant Professor of Mechanical Engineering, Pennsylvania State College
State College, Pa.

In the report of the Committee on Train Resistance and Tonnage Rating, presented at the June, 1916, meeting of the American Railway Master Mechanics' Association, mention was made of the Kiesel method for determining the tractive effort of a locomotive. Inasmuch as a complete derivation of the formulas has not been published, the writer would give here the method and its application, as developed by Mr. Kiesel, using the same notation as outlined in "Principles of Locomotive Operation and Train Control."*

Let T.F. = cylinder tractive force in lb.
D = driver diam. in in.
d = cylinder diam. in in.
l = cylinder stroke in in.
H = total boiler heating surface in sq. ft.†
P = initial cylinder pressure in lb. (considered as 10 lb. less than boiler pressure).
K = evaporation per hour in lb. per sq. ft. of heating surface.
w = weight of 1 cu. ft. of steam in lb. at pressure P.
V = speed in miles per hour.

$$M = \frac{d^2 l}{D}$$

M.E.P. = mean effective pressure.
n = revolutions per minute of drivers.
KH = steam per hour.

Then $\frac{KH}{60}$ = steam per minute.

$$\frac{KH}{60 \times 4 \times n} = \frac{KH}{240\,n} = \text{steam per stroke} \quad \ldots\ldots(1)$$

$$\frac{\pi d^2 l}{1728 \times 4} w = \text{wt. cyl. full of steam} \quad \ldots\ldots(2)$$

$$\text{Expansion ratio} = E = \frac{(2)}{(1)} = \frac{\pi d^2 l}{1728 \times 4} w \times \frac{240\,n}{KH}$$

$$\text{But } n = \frac{1056\,V}{\pi D}$$

$$\text{Therefore, } E = \frac{1056\,d^2 l\,V}{D\,(28.8\,KH)} w$$

$$\text{Or } E = \frac{110}{3} \frac{MV}{KH} w$$

$$\text{M.E.P.} = \text{(nearly)} \frac{2P}{1+E} = \frac{2P}{1 + \frac{110}{3} \times \frac{MV}{KH} w}$$

$$\text{Since T.F.} = \text{M.E.P.} \frac{d^2 l}{D}$$

$$\text{T.F.} = \frac{2\,PM}{1 + \frac{110\,MV}{3\,KH} w} \quad \ldots\ldots(3)$$

Applying equation (3) to the case of a Pennsylvania Rail-

*By Prof. A. J. Wood. Published by the McGraw-Hill Book Company, 239 W. 39th street, New York.

†In case of superheated steam locomotive, multiply the superheater surface by 1.5 and add this to the other heating surfaces. For tubes, take external heating surface.

road H 8 *b* (2-8-0 type) locomotive: Assume $K=10$; other values are, $P=205$—10, $d=24$, $l=28$, $D=62$, $M=206.1$, $H=3{,}839$,‡ $w=.46$ (to nearest second figure).

$$\text{T.F.} = \frac{2 \times 195 \times 260.1}{1 + \dfrac{110 \times 260.1 \times .46 \times V}{3 \times 10 \times 3839}} = \frac{101{,}440}{1 + 0.1143}$$

To obtain the available pull behind the tender, subtract from the above the locomotive and tender resistances.

W = total weight of train in tons.
C = curvature in degrees.
G = grade in per cent.
N = number of cars.
V = speed in miles per hour.
R = total resistance in pounds.

The resistance on a level tangent will be,

$$R = 100N + 1.5W + 0.01V\ (V + 16)\ \sqrt{WN} \quad \ldots\ldots(4)$$

which is for the average train resistance, knowing that there is a possibility of obtaining results about 15 per cent better when car, weather and track conditions are favorable. This does not include resistances due to grades and curves. The average for curve resistance is taken as 1 lb. per ton per degree, or CW.

Grade resistance equals 20 lb. per ton for each per cent of grade, or 20 GW. With these terms added, the formula reads:

$$R = 100N + (1.5 + C + 20G)W + 0.01V\ (V + 16)\ \sqrt{WN} \quad \ldots(5)$$

When the locomotive and tender are included in the train, the weight of train, W, in the above must include the weight of the locomotive and tender, and the number of cars, N, as used, is to be taken as the number of cars back of the tender plus three.

The foregoing arrangement enables one to handle the whole train weight, including that of the locomotive and tender, as a unit, not only for grades and curves, but also for resistance on straight level track.

The locomotive resistances consist of machinery friction and head-end wind resistance, in addition to those mentioned in connection with train resistance.

For machinery friction,

$$R_1 = [22 + 0.15\ (n - 1)\ V]\ Q \quad \ldots\ldots(6)$$

in which Q = weight on drivers in tons.
n = number of pairs of drivers.
V = speed in miles per hour.

For head end wind resistance use Professor Goss' Formula,

$$R_2 = 0.1\ V^2 \quad \ldots\ldots(7)$$

The locomotive and tender resistances, which are here taken the same as for the cars, are subject to the train resistance formulas and will be considered as part thereof, assuming that the engine and tender weights are equivalent to three cars of the same total weight as the engine and tender, and this must be added to equations 6 and 7.

Locomotive capacity expressed in terms of drawbar pull behind the tender is the difference between the cylinder tractive effort and the three resistances noted above.

Consider the available drawbar pull or available tractive effort of the locomotive as cylinder tractive effort, less machinery friction and head-end wind resistance,

$$\text{A.T.F.} = \text{T.F.} - R_1 - R_2$$

(For T.F. see Eq. 3.)

$$\text{A.T.F.} = \frac{2PM}{1 + \dfrac{110w}{3} \times \dfrac{MV}{KH}} - [22 + 0.15(n - 1)V]Q - 0.1V^2 \ldots(8)$$

But, A. T. F. for limiting speed = R. Therefore,

$$\frac{2PM}{1 + \dfrac{110w}{3} \times \dfrac{MV}{KH}} - [22 + 0.15(n - 1)V]Q - 0.1V^2 = 100N +$$

$$(1.5 + C + 20G)W + 0.01V(V + 16)\sqrt{WN} \quad \ldots\ldots(9)$$

From this it will be seen that to determine the drawbar pull of an H 8b locomotive on straight level track, the resistance to be subtracted from cylinder tractive effort is,

‡This value is for the external heating surface, whereas the results for this locomotive as given in the book referred to are obtained by using the internal heating surface.

$$R = (22 + .15 \times 3V)\ 105.5 + .1V^2 + 100 \times 3 + 1.5 \times 200^* + .01V(V + 16)\sqrt{3 \times 200} = 2920 + 51.4V + .345V^2 \ldots.(10)$$

Hence the drawbar pull of the H 8b locomotive may be written,

$$\text{D.B.P.} = \frac{101{,}440}{1 + .1143V} - 2920 - 51.4V - .345V^2 \quad \ldots\ldots\ldots\ldots(11)$$

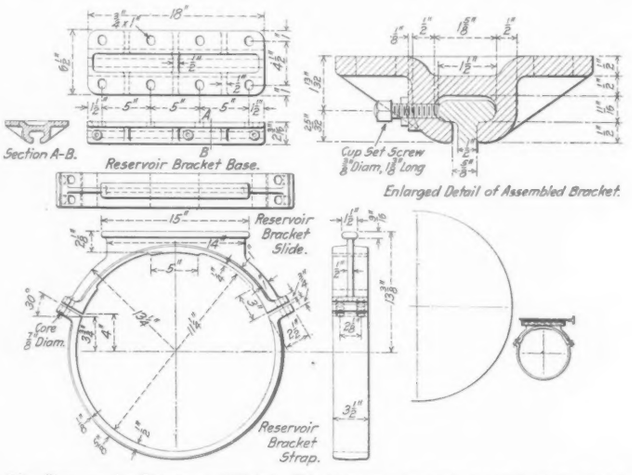
The drawbar pull at varying speeds is given in the following table:

Miles per Hour	Drawbar Pull in lb.
20	26,754
25	22,171
30	18,130
40	12,677
50	8,754

AIR RESERVOIR SUPPORT

The usual method of supporting air reservoirs by means of cast steel brackets and straps has the disadvantage that the reservoirs are difficult to remove and replace. To provide efficient support for the reservoir and at the same time facilitate removal, a bracket composed of a base, slide and strap was designed in the mechanical engineer's office of the Union Pacific.

The malleable iron base is bolted to the underside of the running board, at or near a running board bracket, and remains permanently thereon. The slide and strap are bolted to the main reservoir, and in applying or removing



Air Reservoir Support Which Facilitates Applying and Removing the Reservoir

the reservoir it may be handled with a crane until in position to meet the slot in the base. The reservoir can then readily be slid horizontally into position and the slide secured with set screws.

The brackets may be used interchangeably on all locomotives having the same diameter of reservoir; this eliminates a large variety of bracket castings otherwise needed. They are light and comparatively cheap in cost. On locomotives having the reservoir located alongside the firebox, it is possible to move the reservoir sufficiently from the firebox to permit of inspection of staybolts, which, with the ordinary construction, would be inaccessible.

Use of Pulverized Peat in Sweden.—A recent report of the Swedish Department of Commerce states that the Swedish State Railways have been experimenting with powdered peat as fuel for locomotives, and the railway directors have recommended an appropriation of £70,000 for a factory to produce sufficient powdered peat to supply all the locomotives on one of the state railway lines.—*Mechanical World.*

*The approximate weight, in tons, of the engine and tender is 200.

THE I. C. C. HEADLIGHT HEARINGS

Controversy Over New York Central Tests; Brotherhood Tyranny Is Used to Intimidate Witnesses

A HEARING was held at Washington on October 30 to November 3, inclusive, before the members of the Interstate Commerce Commission to enable the railroads to present additional testimony in connection with the commission's order requiring locomotives to be equipped with high-power headlights with sufficient intensity to enable persons with normal vision, in the cab of the locomotive, to see a dark object the size of a man for a distance of 1000 feet, under normal weather conditions. The commission has postponed the effective date of its order until January 1 and the hearing was called for the purpose of taking testimony regarding a series of tests made near New York on September 28, at which Commissioner Clark and the officers of the commission's boiler inspection department were present.

The hearing at once developed into a contest between the representatives of the railroads and the officers of the engineers' and firemen's brotherhoods, who challenged the fairness of the test, which they had refused to have anything to do with, and sought to prevent the introduction of further testimony. The commission, however, granted the request of the railroad attorneys, C. C. Paulding, solicitor of the New York Central, D. E. Minard, assistant general solicitor of the Erie, and S. B. Lloyd, assistant general counsel of the Pennsylvania, and ruled that each side should be allowed to present 20 witnesses before an examiner and that the evidence need not be confined to the New York test. The hearing before the commission was confined to one witness representing the carriers, one representing the employees and one called by the commission. A. G. Trumbull, assistant to the mechanical superintendent of the Erie, testified regarding the tests for the roads. A. G. Pack, assistant chief boiler inspector, was called as a witness by W. S. Carter, president of the Brotherhood of Locomotive Firemen and Enginemen, and G. E. Murray, headlight electrician, Chicago & North Western, was called as a witness for the commission.

Mr. Trumbull gave a detailed description of the tests, in which steam and electric locomotives were used, equipped with 250-watt, nitrogen bulb electric headlights furnished by the Pyle-National Company, with 9-in. by 18-in reflectors. The headlights were adjusted by a representative of the headlight company. His testimony relative to the effect of the light from high-power headlights on the reading of signals, the observation of tail lights and markers as well as the locating of flagmen, indicated that the high-power light is confusing and dangerous under operating conditions similar to those of the tests.

In the tests to see at what distance objects on the track could be seen, a man dressed in dark blue overalls walked down the track toward the locomotive. John McManamy, assistant chief inspector of locomotive boilers, thought he saw the object at a distance of 2,389 ft., but after the distance had been measured he asked for a re-test and saw the man at a distance of 994 ft. A. G. Pack, assistant chief inspector, saw the "object" at a distance of 772 ft. and various railroad mechanical officers at distances ranging from 552 to 764 ft.

Mr. McManamy, in cross-examining the witness, sought to show that the tests were not conducted under representative conditions, and showed that the witness had had comparatively little recent experience in riding locomotives at night. Mr. Carter also questioned the manner of conducting the test, but the witness said it was conducted under actual operating conditions.

Mr. Pack testified that he had run an engine with an electric headlight for 11 years on the Colorado Springs & Cripple Creek District, before becoming connected with the commission, and had never experienced any difficulty with them. Although he admitted that his road was mostly single track with no block signals he said he ran into a station facing an electric headlight on the locomotive of another road and could see the order boards back of the light as plainly as he could if it had been an oil headlight. Mr. Pack said that he had never experienced any difficulty in seeing flags or reading signals governing the track on which he was running, with electric headlights, that he never saw any "phantom" signals or confusing indications caused by high power lights. Cross-examined by Mr. Paulding he said that he was having trouble with his eyes on the night of the test, caused by a pair of new glasses, that some steam leaking from the locomotive occasionally interfered with vision, and that the headlights used did not seem to be giving results up to standard. He said he had interviewed more than 1,000 engineers who had operated with electric headlights and had never heard one express an unfavorable opinion of them.

Mr. Murray testified in favor of the electric headlights, saying they had given satisfactory results on the North Western. Asked whether he thought the proposed rule of the commission was a feasible one for all roads, he said it would be necessary for each road to study its own conditions and to adopt the type of light most suited to its requirements. In reply to a question by Chairman Meyer he said he did not raise any question about the fairness of the test.

The remainder of the hearing was held before Examiner-Attorney E. W. Hines. J. Doherty, road foreman of engines of the Michigan Central, who was a locomotive engineer up to ten months ago thought that electric headlights were a positive menace to safe or prompt transportation on multiple tracks and said that the better the light the worse it is in a fog because of the effect of the moisture in the air on the rays of light. He said that if dimmers were used when passing stations or signals they would have to be used most of the time on a busy railroad. Mr. Doherty said that the views of most engineers he talked with agree with his.

Among the 20 witnesses called by the railroads were several engineers who presented remarkable testimony as to the methods of the Brotherhood of Locomotive Engineers in dealing with its members who disagree with the legislative plans of the brotherhood officers.

W. H. Rother, an engineer employed on the Cleveland, Cincinnati, Chicago & St. Louis, testified that he had been tried and acquitted by his local division of the brotherhood, No. 492, at Indianapolis, on charges preferred by Grand Chief Engineer Warren S. Stone of violation of the "laws" of the brotherhood in testifying before the Interstate Commerce Commission on September 30, 1915, that he regarded electric headlights as dangerous. After his acquittal, Grand Chief Stone had recalled the charter of Division 492 and organized a new division, No. 546, in its stead, excluding Rother, together with those who had voted for his acquittal, and those who had refused to obey an order to refrain from associating with Rother.

J. T. Heller, another Big Four engineer, testified that he had been expelled from Division 143 of the brotherhood on charges preferred by Stone because of his testimony before the Interstate Commerce Commission.

A. E. Martin, also a Big Four engineer, said that he had been excluded from Division 546 and ostracized by his fellow members for acting as Rother's attorney at his trial, and that the only evidence presented against Rother was a

copy of his testimony before the Interstate Commerce Commission.

O. P. Keller, an engineer employed on the Pennsylvania Railroad, testified that he had been tried and acquitted by his local division, No. 74, on charges preferred by order of Grand Chief Stone because he had expressed an opinion unfavorable to electric headlights in the presence of a member of the Pennsylvania legislature, and that he had afterward been expelled on charges preferred by Stone because he had joined the Pennsylvania Mutual Benefit Association. He also testified that he had sent to the Interstate Commerce Commission a copy of a circular addressed by Mr. Stone to members of the brotherhood, threatening them with expulsion if they interfered with the plans of the brotherhood in connection with headlight legislation.

D. P. Trostle, an engineer on the Philadelphia & Reading, testified that H. E. Wills, legislative representative of the Brotherhood of Locomotive Engineers, and A. G. Pack, assistant chief inspector of locomotive boilers of the Interstate Commerce Commission, had warned him while in the hearing room of the Interstate Commerce Commission on October 30 that he would be violating the laws of the brotherhood if he testified unfavorably to high-power headlights.

These engineers were allowed by the Interstate Commerce Commission to present their testimony only after vigorous objection by Mr. Stone and W. S. Carter, and after the hearing had been interrupted for a day while the commission deliberated over a statement filed by counsel for the railroads, outlining the character of the evidence they proposed to introduce. After the testimony had been allowed, Mr. Stone admitted the principal facts alleged and identified copies of letters which he had written bearing on the cases.

The sections of the "Constitution and Statutes" of the Brotherhood of Locomotive Engineers under which members have been expelled for giving testimony before the Interstate Commerce Commission are given herewith:

"Members Interfering with Board—Penalty."

"Sec. 11. Any member or Division refusing to sustain the official acts or instructions of the Legislative Board, or who circulates or signs any petition, or who, by verbal or written communication to railroad officials or others, calculated to injure or interfere with legislative matters offered by the Legislative Board or at any time makes suggestions to railroad officials or to state legislators that may be detrimental to the interests of the B. of L. E., or any train service organization, shall be expelled, when proven guilty, as per Sec. 49 of the Statutes."

"Interfering with National Legislative Matters."

"Sec. 12. Any member or Division who, by verbal or written communication to anyone calculated to injure or interfere with national legislative matters, offered by our Legislative Representative at Washington or Mexico, or at any time makes suggestions to anyone that may be detrimental to the interests of such legislation, shall be expelled, when proven guilty, as per Sec. 49 of the Statues."

Nearly a score of engineers running fast passenger trains on roads entering New York City testified that, in their opinion, electric headlights would be a positive menace to safety of operation in their territory because they obscured signals and temporarily blinded engineers who had to face such headlights approaching from the opposite direction. Some of them had had experience with electric headlights on their own engines, others had faced them on electric trolley lines paralleling their own lines, and all of them had been present at tests with electric headlights made on the New York Central recently. In addition, 45 locomotive engineers and 13 road foremen of engines and locomotive inspectors presented to the commission through counsel for the railroads a petition that they be allowed to testify, but the commission declined to change the ruling it had previously made limiting the number of witnesses to 20 for the railroads and 20 for the brotherhoods.

Frank McManamy, chief inspector of locomotive boilers of the Interstate Commerce Commission, took the stand as the first witness for the brotherhoods. He said that before recommending to the commission the rule requiring a headlight which would enable a dark object the size of a man to be seen for a distance of 1,000 feet down the track, he had made such investigation of the subject and such tests as time permitted and that he had examined the headlight laws of 31 states, mostly in the west and south. Most of these laws require electric headlights, while some specifically prescribed electric headlights. He had chosen the distance basis to make the rule enforceable, as apparatus for the measurement of candlepower was too cumbersome for inspection purposes. He emphasized the fact that the order permits the use of dimmers to reduce the intensity when passing stations or other trains. He thought the conditions of the New York Central tests were not entirely favorable, especially as to the observation of men on the track, as they were partially obscured by shadows and curves. However, he thought this was the least important feature of the tests because he thought the lights used were of even greater than the required intensity. He said that it was raining intermittently during the tests, that he had not been consulted in detail about the arrangements for the tests, and that he had been given no opportunity to inspect the lights on the night of the test. He said he had experienced no difficulty in reading signals.

John McManamy, assistant chief inspector of locomotive boilers, described his experience at the tests at New York and said that he had found no difficulty in reading signals, but that he thought the lights were not in proper condition.

A large number of engineers employed on western railroads that have used electric headlights for years testified as witnesses for the brotherhoods and expressed a preference for electric headlights, saying they had never had any difficulty in reading signals and that they believed that the high-power light was a safety device. An engineer on the Chicago & North Western said that their lights were focused so that the beam of light strikes the track at a distance about 300 feet in front of the engine so they do not shine directly into the eyes of an engineer on the opposite train. The brotherhoods completed their case without giving any rebuttal testimony to the charges of intimidation and coercion.

R. B. Kendig, chief mechanical engineer of the New York Central, and D. F. Crawford, chairman of the Headlight Committee of the American Railway Master Mechanics' Association, and general superintendent motive power of the Pennsylvania Lines West, gave rebuttal testimony for the railroads. He stated that he would never take the responsibility for putting electric headlights on any road and that the danger increased in proportion to the density of traffic, the number of trains and the number of signals. He stated that a proper rule would prescribe the minimum that would be suitable under the most congested conditions and allow each road to use more intense light if desired.

After the taking of testimony had been completed the hearing of oral arguments was set for November 27. After listening to the arguments which were presented at that time, the commission took the matter under advisement without comment.

In his argument, Solicitor C. C. Paulding, representing the railroads, pressed the point upon the commission that what might be satisfactory and safe on one railroad might be impracticable and dangerous on another, because of the variance of local conditions, and that what can be used on the single-track lines in the sparsely-settled regions of the West might be utterly impossible on the multiple-track roads of the East and in the congested districts and suburbs around the big cities.

A feature of Solicitor Paulding's argument was the statement that the brotherhood chiefs, in expelling engineers from membership for testifying to their belief that the electric headlights are dangerous, had violated the Federal Penal Code, which prescribes a fine of $5,000 and six years' imprisonment for intimidation or wrongful influencing of witnesses in a proceeding before a United States court or commissioner. The railroads' counsel scathingly denounced the brotherhood constitution provision providing that "any mem-

ber who interferes with a legislative matter being conducted by the legislative board shall be expelled." He called attention to the warnings sent broadcast to engineers that they were subject to expulsion if they testified.

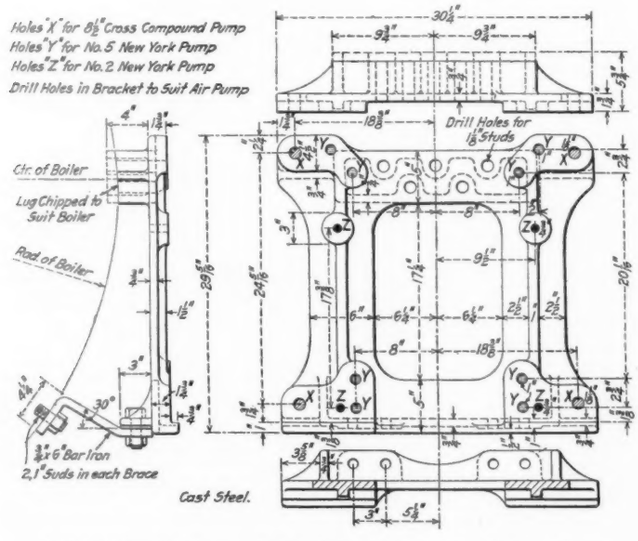
With the testimony of the brotherhood witnesses so directly contradictory of all the mass of testimony of engineers and others who testified of difficulties in vision through false colors, reflections and blinding glare from the high-power lights, as produced by the railroads, the two could not be reconciled and it resolved itself into a matter of the credibility of the witnesses. He urged the commission to consider that 85 engineers had appeared voluntarily to testify against the "searchlights" in spite of the drastic punishment inflicted upon a score of their fellows for giving evidence previously and in face of the fact that under the law of the brotherhood they could be expelled for attending. He said that the sworn testimony given at such great personal risk, all corroborative of the contentions of the railroad operators, was entitled to the utmost credence. He quoted numerous expressions, including that of one engineer that he had voluntarily come "to protect myself and the public against the enforced use of a device which means death."

Grand Chief Stone made the only argument for the electric headlights, speaking for two hours and citing the testimony of member engineers that they had had no trouble whatever in using the intense headlights on western roads, such as being blinded by the dazzling glare when trains meet, misreading of signals through false colors, phantom lights and reflections, as described by a score of engineers called by the carriers and testified to as the result of numerous tests. He insisted that the electric headlights should be considered a safety device.

ADJUSTABLE AIR PUMP BRACKET

It is usual for a railroad to maintain a variety of air pump bracket castings to fit various sizes of air pumps and diameters of boilers, as well as to suit the vertical location of the bracket relative to the center of the boiler, on different classes of locomotives.

In an effort to reduce the number of brackets required,


Holes "X" for 8½" Cross Compound Pump
Holes "Y" for No. 5 New York Pump
Holes "Z" for No. 2 New York Pump
Drill Holes in Bracket to Suit Air Pump
Ctr. of Boiler
Lug Chipped to Suit Boiler
Rad of Boiler
Drill Holes for 1⅛" Studs
¾" x 6" Bar Iron
2, 1" Studs in each Brace
Cast Steel.

Adjustable Air Pump Bracket in Use on the Union Pacific

the design as illustrated was developed by the mechanical department of the Union Pacific. A light, but strong steel casting, having at its upper end a suitable chipping boss, and at its lower end lugs designed to take the ends of bar iron braces, constitutes the support for the pump. Bosses cast on the face of this casting are arranged to take studs for three different styles of pumps: the Westinghouse 8½-in. cross compound pump, and the No. 2 and No. 5 New York pumps.

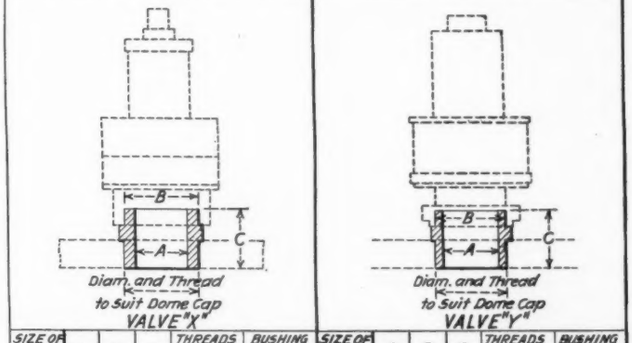
Any variation in the fit of the bracket to the locomotives is taken care of by increasing or decreasing the length of the bar iron braces, this being clearly indicated in the illustration.

SAFETY VALVES

BY M. J. CAIRNS

The instructions on the reverse side of the government alteration report, Form 19, request, under item *F*, that changes in the number or capacity of safety valves from those shown on the original specification card shall be reported on an alteration report. It is fair to assume that the back shop and roundhouse forces on many roads are not aware of the number and size of the safety valves shown on the specification card, as those cards are usually on file in the mechanical engineer's office. As a means of giving the shops this information it is suggested that a drawing conveying the information shown in Fig. 1 be made and that blue prints be posted in roundhouses and back shops with instructions that it be referred to when making a change in the safety valves. As the valves shown on this drawing

VALVES									
ENGINE NO.	OPEN		MUFFLED		ENGINE NO.	OPEN		MUFFLED	
	NO.	SIZE	NO.	SIZE		NO.	SIZE	NO.	SIZE
460 - 490	1	3½"	1	3½"	760 - 790	2	3½"	-	-
501 - 525	2	3"	1	3"	801 - 850	2	3½"	1	3½"
601 - 630	1	3"	1	3"	1201 - 1225	2	3"	-	-



SIZE OF VALVE	A	B	C	THREADS FOR "B"	BUSHING PATT. NO.
2½"	2"	2 7/8"	3 5/8"	2½" Pipe	A-809
3"	2 5/8"	3½"	3 5/8"	3" Pipe	A-806
3½"	3 5/8"	4"	3 5/8"	3½" Pipe	A-807

SIZE OF VALVE	A	B	C	THREADS FOR "B"	BUSHING PATT. NO.
2½"	2 5/8"	3 1/8"	3 5/8"	11½ STRAIGHT THREADS	A-805
3"	2 5/8"	3 5/8"	3 5/8"	11½ "	A-806
3½"	3 5/8"	3 5/8"	3 5/8"	10 "	A-807

Fig. 1—Suggested Tabular Arrangement for Safety Valve Data

should represent those which will properly relieve the boiler it will be well to check their number and size by the Master Mechanics' formula which is given below, assuming that the valves have a 45 deg. seat.

$$D = .036 \times \frac{H}{L \times P}$$

In which

D = the total of the actual diameters of the inner edge of the valve required.

H = total heating surface of boiler in square feet (superheating surface not to be included).

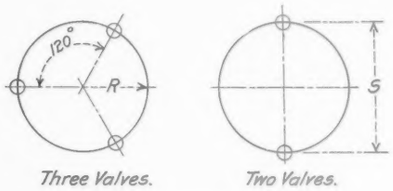
L = vertical lift of valve in inches.

P = absolute boiler pressure (boiler pressure plus atmospheric pressure) in pounds per square inch.

The lifts for the various valves can be obtained from the manufacturers.

The locomotives can be arranged in numerical order or by

classes, whichever is preferable, and the number, size and style of the valves should be shown in the space provided, it being understood that no valve smaller than those shown in the table shall be applied. It will, of course, be permissible to apply valves larger than those shown in the table if the correct size is not on hand. It is common practice on some roads to equip switch, passenger and road engines in switching service with one muffled and one or two open valves, equipping freight engines with all open valves; it is claimed that no objection can arise from the noise of an open valve if no objection arises from the shriek of a whistle.



Valve Size	Spacing S	Radius R
4½"	9"	5 3/16"
4	8½	4⅝
3½	8	4⅝
3	7¼	4 3/16
2½	6½	3¾

Fig. 2

This in itself is an economy as muffled valves are usually more expensive than open valves.

For new work, and perhaps for replacements, the spacing of valves shown in Fig. 2, which is recommended by the Master Mechanics' Association, can be used to advantage.

The brass bushings shown in Figs. 3 and 4 will be found an improvement over a pipe bushing on account of their better wearing qualities. Furthermore, the valves can be removed from the brass bushing without the injury they are at times subjected to when pipe bushings are used. The distance between the bottom of the valves and the dome cap should be as short as possible, leaving just enough space for

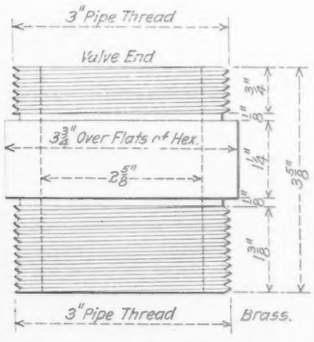


Fig. 3—Bushing for 3-inch Valve

the use of a hexagon wrench. A long bushing with the consequent vibration of the valve when it is blowing is injurious to the valve. Fig. 4 shows a reducing bushing which can be used when applying the smaller valves to the engine. If the valves on the road are all of a standard make, these bushings can be carried in stock threaded, otherwise they should be left blank and threaded to suit the dome cap and valve as required.

Safety valve springs are usually designed to carry a pressure of 10 lb. under or over the pressure stamped upon them, although some manufacturers allow a variation of 15 lb. It is, therefore, important that the shops not only compare the size of valve with the above mentioned drawing but also compare the spring capacities. This is most important when changing valves from one engine to another. It is suggested that springs at 150 lb., 170 lb., 190 lb. and 210 lb. be carried in stock as standard rather than carrying a number of springs with pressures varying 5 lb. or 10 lb. This not only greatly reduces the number of springs carried in stock but also protects all engines on account of the range of 20 lb. allowed each spring. As the outside diameter of the spring is usually alike for safety valves of the same size, type and make, one valve body and several spare springs can be carried in place of several complete valves with springs at

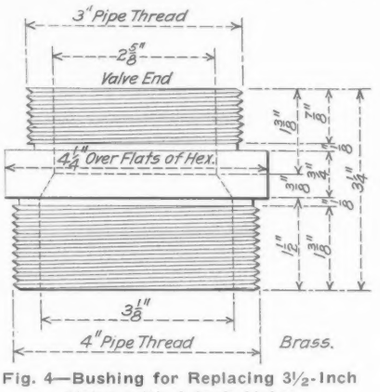


Fig. 4—Bushing for Replacing 3½-Inch Valve with 3-Inch Valve

various pressures. The store department can protect the entire equipment by carrying a spare valve for each 50 engines.

Too much importance cannot be given to the obtaining of correct valves on locomotives and it will be found a paying proposition to assign one man at each shop to handle the application of safety valves.

REPORT OF I. C. C. DIVISION OF BOILER INSPECTION

The summary of the work of the division of boiler inspection of the Interstate Commerce Commission is included in the report of the commission for the year ending June 30, 1916, which has just been published. During the year the jurisdiction of the division has been extended to include the entire locomotive and tender. The work of the division in inspections and accidents reported, including all parts of the locomotive and tender since the extended jurisdiction became effective, is summarized in the following table:

Number of locomotives inspected	52,650
Number found defective	24,685
Percentage found defective	47
Number ordered out of service for repairs	1,943
Number of accidents	537
Number killed	38
Number injured	599

Separating the accidents, and casualties resulting therefrom, due to boilers and their appurtenances only, from those due to other parts of the locomotive, it shows that there were 352 such accidents, with 29 killed and 407 injured thereby. This is a decrease over the preceding year in the number of accidents and in the number of casualties, but an increase in the number killed due almost entirely to crown sheet failures due to low water, and forcibly emphasizes the importance of properly maintaining water gages and boiler feeding appurtenances.

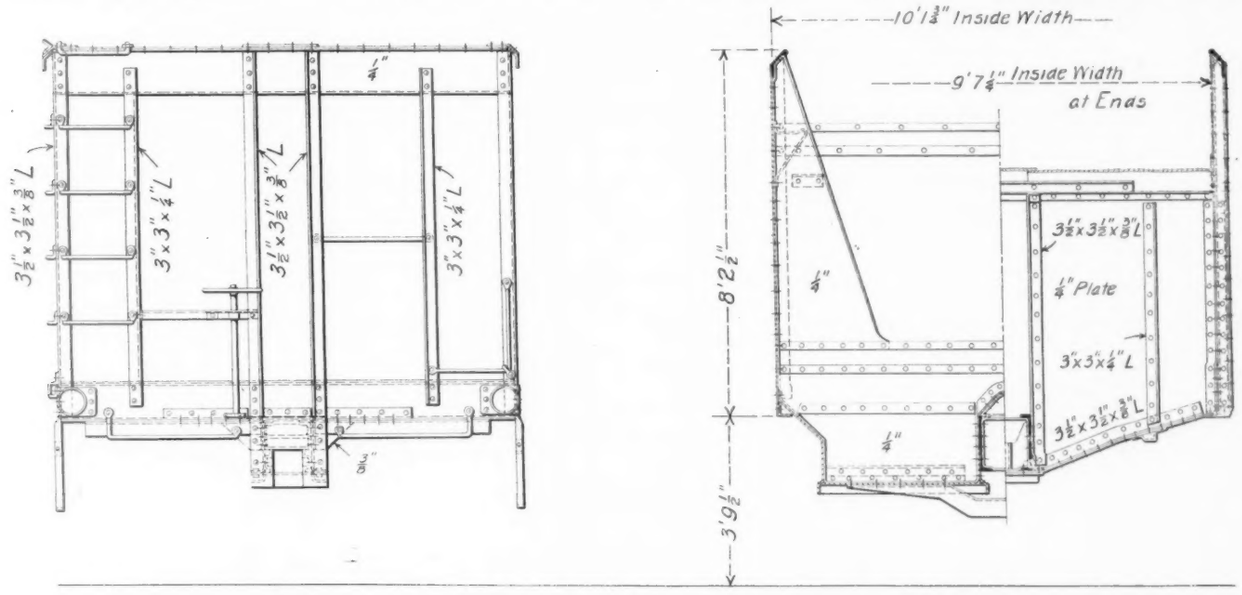
A total of 653 applications for extension of time for removal of flues, as provided in rule 10, were filed during the year. Investigation disclosed 103 of the locomotives in such condition that no extension could properly be granted; on 79 locomotives the conditions were such that the full extension asked for could not be granted, but an extension for a shorter period was allowed. Sixty-three extensions were granted after defects disclosed by our inspections had been repaired; 43 applications were withdrawn. The remaining 365 were granted as requested.

Car Department

HOPPER CAR OF 200,000-LB. CAPACITY

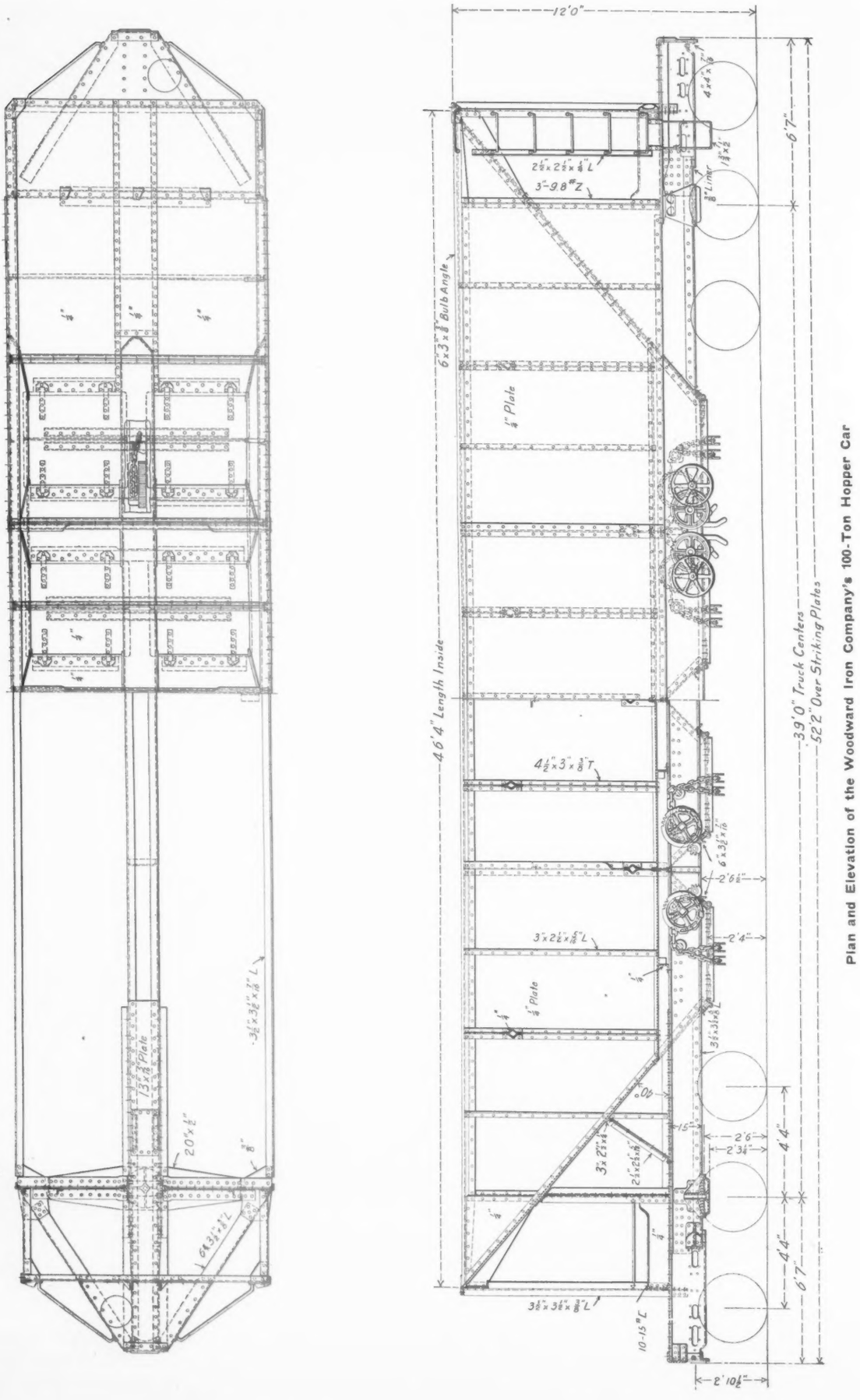
Although there are several cases where hopper cars of greater than 50 tons capacity are in use, the 50-ton car is still the standard for this type of equipment. Until recently the most notable examples of higher capacity equipment were the 90-ton high side gondola cars which have been in service on the Norfolk & Western since the latter part of 1912. A car of 100 tons rated capacity, however, has been built for the Woodward Iron Company, Woodward, Ala., by the Pressed Steel Car Company, which has now been in coal carrying service for about two years, during which time its performance has been very satisfactory. The first year that it was in service it handled 11,800 tons of coal with no repairs to the car whatever, the only repairs being to air brake hose.

The car is 52 ft. 2 in. long over the striking plates and has a maximum height of 12 ft. above the rails. It will be noted that the hopper angle is 40 deg. from the horizontal, this having been adopted to make the car self-cleaning for ordinary run-of-mine coal. The use of this angle limits the length of the hopper at the top to 46 ft. 4 in., the use of the space at either end over the outside wheels of the six-wheel truck being thus impossible. The cars are 10 ft., 1¾ in. wide inside and have a capacity of 3,600 cu. ft. The light weight is 75,300 lb., and considering the maximum carrying capacity



End Elevation and Cross Sections of the Woodward Iron Company's 100-Ton Car

100-Ton Coal Car—Woodward Iron Company



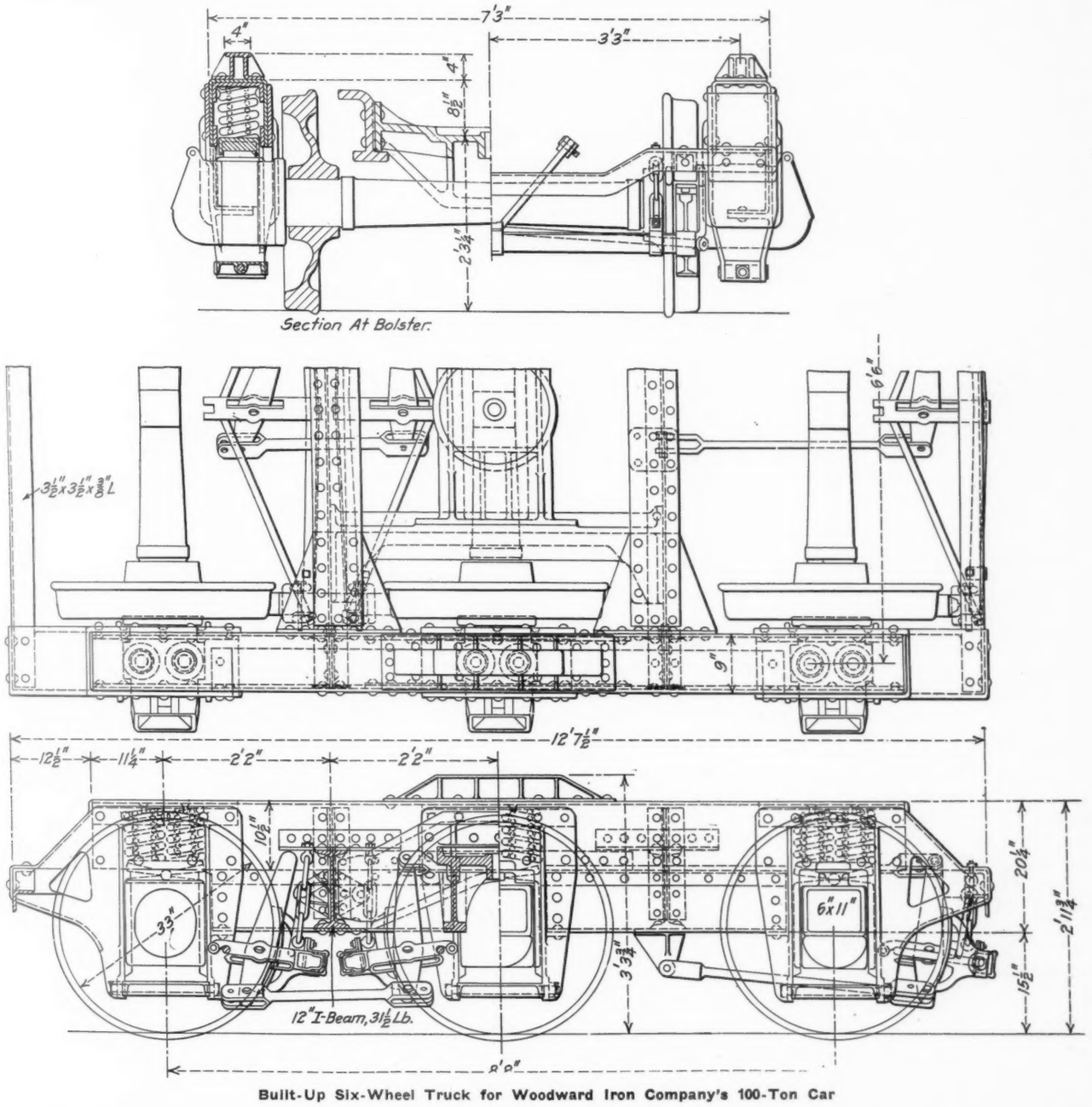
Plan and Elevation of the Woodward Iron Company's 100-Ton Hopper Car

as 10 per cent overload, the ratio of revenue load to total weight of car and lading is 74.5 per cent. This is somewhat less than the same ratio for the Norfolk & Western cars referred to above. These cars with a maximum capacity, including 10 per cent overload, of 198,900 lb. and a light weight of 59,000 lb.,* have a ratio of revenue load to total load of 77 per cent, six-wheel trucks being used in both cases. The ratio is better, however, than the average 50-ton car with four-wheel trucks, which is about 72 per cent.

The underframe is of the through center sill design, the sills being 15-in. channels placed with the flanges inward and having a width from back to back of 13 in. Top cover plates 5/16 in. thick and 13 in. wide extend from about 12 in. inside the hopper to the end sill and the bottom flanges are stiffened by the use of 3½-in. by 3½-in. by ⅜-in. angles riveted to the outside of the sills. These extend from the hopper to the draft sills. The end sill is a 10-in., 15-lb. channel, which is placed across the top of the center sills, 2 ft. 11 in. back of the striking plate. The projecting ends of the center sills are stiffened by means of 6-in. by 3½-in. by ⅜-in. angles extending from the end of the sills to the ends of the transom, to which they are attached by means of ⅜-in. horizontal gusset plates. In front of the end sill the center sill cover plate is widened to form a deck, completely covering the space between the center sills and the diagonal stiffeners.

The transom is of unique construction. It is carried from the center and side sills up to the bottom of the hopper sheet and consists of vertical ¼-in. plates extending from either side of the center sill to the side of the car, the edge of the plate at the center sill being stiffened vertically by two 3½-in. by 3½-in. by ⅜-in. angles, one on either side, at a point above the side bearing by one 3-in. by 3-in. by ¼-in. angle placed on the side of the sheet toward the end of the car, and at the

*A more recent design of this car has a weight of 53,000 lb.



Built-Up Six-Wheel Truck for Woodward Iron Company's 100-Ton Car

outside to the back of a 3-in. by 3-in. by ¼-in. angle and the web of a 3-in., 9.8-lb. Z-bar. These two members in effect form the cornerpost of the body side frame. The space between the end of the end sill and the transom is closed by a ¼-in. pressed steel channel, the upper flange of which is flattened out to permit the end of the piece to be riveted between the flanges of the angle and Z-bar members of the post. Flanges are formed at the lower end of the transom plate by two 3½-in. by 3½-in. by ⅜-in. angles, one placed on either side; at the outer end these are riveted to a ⅜-in. gusset plate to which are also attached the flanges of the body and end sections of the side sill and the diagonal channel stiffeners. The two sections of the transom are further stiffened and securely tied to the center sill by a ½-in. bottom cover plate, extending across the center sill from gusset plate to gusset plate. This cover plate tapers from the width of the transom flanges at the ends to a width of 20 in. under the center sill. Pressed steel diaphragm fillers are placed between the center sills at points about half way between the ends of the hopper and the center of the car, and the center castings form fillers at the transoms. The side sills are 3½-in. by 3½-in. by 7/16-in. angles.

The end plate is a ¼-in. pressed steel member of Z-bar section, to which is riveted the upper end of the hopper sheet. The end of the hopper is supported by four 3½-in. by 3½-in. by ⅜-in. angles, one at each corner and one on either side of the center sill. In addition to these members two 3-in. by 3-in. by ¼-in. angles are provided to support the ends of the grab irons and ladder irons. The end hopper sheet is a ¼-in. plate, which is supported throughout its width at the transom and from the center sills at a point midway between the transom and the bottom of the hopper. On the interior of the car the center sills are covered with a housing of ¼-in. plate, which extends below the sides of the sills to form the inside portion of the drop door frames.

There are four sets of doors, those on opposite sides of the center sill being joined by special pressed steel channels, to the center of which are attached the door chains, the operating mechanism being housed between the center sills. To make the car entirely self-clearing, the space between adjoining sets of doors is hoppered, the hopper sheets being supported from transverse stiffeners of ¼-in. plate which extend vertically across the car. At the top these stiffeners are flanged to form a half-diamond section, the diamond being completed by a similar section, riveted in place.

The sides of the car are braced to these members by pressed steel plates, ¼-in. thick, the lower edges of which are riveted between the two pieces of the transverse stiffeners. The sides of the car are also joined near the top by four cross ties of diamond section, the ends of which are secured to vertical stiffeners of 4½-in. by 3-in. by ⅜-in. T section. Longitudinal stiffness of the sides at the top is provided by a 6-in. by 3-in. by ⅜-in. special bulb angle.

The cars are carried on six-wheel trucks, the distance between truck centers being 39 ft. The truck is of pressed steel construction, having a wheel base of 8 ft. 8 in. The principal member of the side frame is an inverted U-section of ½-in. plate, 9 in. wide by 10½ in. deep, the outside flange of which is riveted to a pressed steel angle, which gives the frame a total depth of 20¼ in. between the pedestals. The transoms are 12-in., 31.5-lb. I-beams, which are securely framed and gusseted to the side frames and provided with top and bottom cover plates 7½ in. wide by ½ in. thick. The transoms are located 2 ft. 2 in. on either side of the center of the truck and support two heavy longitudinal steel castings which carry the cast steel bolster.

The pedestals are steel castings and are riveted to the side frames. The load is transmitted from the side frames to the journal boxes through two 6¼-in. by 8-in. double coil springs over each journal box. The springs do not rest directly upon the top of the box, an equalizing spring seat being interposed between the box and the springs. The pedestals are closed at the bottom with binders. The wheels are 33 in. in diameter and are mounted on axles with 6-in. by 11-in. journals.

PORTABLE CUT-OFF SAW

BY E. W. HARTOUGH
General Foreman, Car Department, Missouri, Kansas & Texas, Denison, Texas

A portable saw, which is operated by compressed air, has been developed and placed in service in the car repair yards of the Missouri, Kansas & Texas, at Denison, for cutting up roofing, decking, lining and siding. It has proved to be both a time and money saver, as it permits the handling of the lumber directly from the pile to the saw and thence to the supply car, to be delivered about the yard wherever needed, thus eliminating handling to and from the mill.

The saw is mounted on the end of a table 10 ft. long by 2 ft. wide and is operated by a compressed air motor. The saw carriage and motor are moved back and forth in a four-rail guide, two rails being placed above, and two below the saw. The inner rails are bolted to the legs of the table and the outer ones are riveted to brackets which are attached to the table legs. Four small grooved wheels attached to the carriage operate on the rails. A wooden hood is provided to protect the operator when the saw is not in use.

A narrow-gage track runs the full length of the lumber yard parallel to the supply track. This provides a means

Portable Saw Used in Car Repair Yards

of moving the saw directly to the pile in which the lumber to be cut is stored and, when cut to length, the material may be loaded directly onto a supply car for delivery to the repair tracks.

While compressed air is undoubtedly expensive power, the saw uses very little air, as the power is shut off at all times except when the saw is actually in operation. The motor is started on pulling the saw forward towards the lumber and is shut off again automatically as soon as the cut is completed and the saw pushed back to its original position. The motor which has been applied to the saw was manufactured by the Baird Pneumatic Tool Company, Topeka, Kansas, and operates at from 1,900 r. p. m. to 2,000 r. p. m. The saw is 14 in. in diameter and readily cuts through a pile of six sheathing boards at one time. A saw of this kind can be used advantageously at any small repair yard, where compressed air is available for testing air brakes. If compressed air is not available it is possible to use a small electric motor.

With this one saw it has been possible to cut all the material used by 100 piece workers and with plenty of small supply cars available, no extra handling is necessary.

CAR INSPECTORS' AND FOREMEN'S MEETING

Individual Papers and Committee Reports a Most Important Feature of the Proceedings at Indianapolis

FOR the first time in its history a number of individual papers or reports were presented at the annual meeting of the Chief Interchange Car Inspectors' and Car Foremen's Association, which was held at Indianapolis, Ind., last October. The account of this meeting which appeared in our November issue was concerned principally with the discussion of the changes in the rules of interchange, and included also the first prize article in the competition which was held by the association on car department apprenticeship. The second prize article in this competition and some of the individual papers follow. Other reports will be published in the January number.

FREIGHT CAR MAINTENANCE

BY L. J. JUSTUS
New York Central

The importance of freight car maintenance cannot be overestimated, as the amount annually spent for this purpose staggers the imagination. The all-important matter is how to spend this vast sum of money so that the best possible results will be obtained. Shall it all be spent in maintaining the present light capacity wooden cars, repairing them to their original standard when broken or worn out, or shall a part of it be spent in "betterments" strengthening this type of car by applying steel underframes, steel or strengthened ends, up-to-date draft rigging, steel carlines, metal roofs and doors that are not liable to drop off and will prevent water getting into the car and damaging the lading? Much depends on the decision of these questions. It has been the experience of a large railroad that the wooden car, especially the box car, in a generally good condition, should be repaired with a steel underframe, having an improved draft-rigging and strengthened ends, rather than to be repaired to its original standard.

These are the three courses open to the car owner; if sufficient money is available, the old cars may be torn down and replaced with large capacity steel or steel underframe cars. If money is not so abundant, which is the usual condition, the wooden car, particularly the box car, of not less than 60,000 lb. capacity, can be rebuilt with a steel underframe, improved draft-rigging, strengthened ends, etc.; or if the size of the box car is large enough, it could have new trucks of larger capacity, the carrying capacity of the car thereby being increased. The point is often brought up by those in charge of repairs of freight equipment on the smaller roads having light locomotives, that the present wooden car is all right and that they can handle their business satisfactorily with it in its present condition without spending large sums of money to strengthen it. This point might be well taken if their cars always remained on their own roads, hauled in short trains by small locomotives, but this is not the case. These cars go all over the country and are subjected to the same conditions of service as the modern steel or steel underframe cars, hauled in the same trains and subjected to the same hump yard switching, with the result that the center sills are cracked or split, the draft arms or bolts broken, allowing the draft arms or the coupler to be pulled out.

Particular attention should be called to the importance of maintaining the doors of box cars in good condition. It is not an uncommon thing to see doors having no metal stiffeners at the bottom, with the corners torn out or rotted away at the point where they should engage the door guides, swinging in and out as the train moves along, with nothing to hold them in place but the door hasp, and liable at any minute to drop to the ground. All doors, when rebuilt, should have a substantial metal bottom stiffener and not less than four deep door guides, securely fastened to the car and a good strong door hasp fastened to the door with at least four bolts. The hasps should, by all means, pass through one of the horizontal battens, all of which should extend the full width of the door. The door should have a good track, substantial hangers, and interlocking spark-strips, which will hold the door securely in place and prevent water leaking into the car around the edges. The practice of "repairing in kind" cars having wooden door

stops is another bad thing, as the hasp fastener attached to the wooden door stop with two bolts will not stand modern service conditions, and the wooden door stop is soon split and the hasp fastener torn out. I am sorry to be obliged to say that I have seen new cars built this year with wooden door stops, and with hasp holders attached to the door with only one bolt. The repairs to damaged ends are often made with no regard to strength. If the top is pushed out it is crowded back into position and held in place only by a few nails and a new fascia board; if the end sill or an end post is broken, a new one is applied and the end posts fastened to the end sills only with nails and some new end sheathing boards applied. This end, after repairs are made, looks all right, but has not the strength to withstand the shocks that it will be subjected to.

Just as much importance should be attached to the quality of the work turned out as to the quantity. It has been found from a thirty-day record kept on 6,000 miles of railroad that steel and steel underframe cars are in for repairs to draft sills and draft attachments not oftener than once a year and the modern cars considerably less than that, while wooden cars, with wood draft arms, are in for the same class of repairs about two and one-half times a year. It has been the experience of at least one road that wooden cars equipped with properly designed repair steel underframes will hold their own in service with modern steel and steel underframe equipment, and that there is a marked reduction in repair bills when these cars are on foreign roads, especially if they also have steel ends. The present practice of replacing arch bar trucks with cast steel side frames is a move in the right direction, as it does away with some bolts that have always given us much trouble to maintain. Standardization of the design of parts is one reason for the great reduction in maintenance cost.

We should at all times report to the proper officers to have defective designs improved to obtain easier, better and cheaper maintenance. If there is some weak point in a certain series of cars, which is constantly failing, we have not done our full duty by simply repairing these cars. We should earnestly devote ourselves to the task of overcoming this inherent defect in existing cars, in design or material, by such changes as will strengthen the part that has given the trouble and thus put a stop to this unending repairing of this particular defect. In the designing of new equipment the men that are in actual charge of the maintenance should be consulted and work with the designers of the equipment, not only at the time when the cars are designed, but after the cars are in service, following them up and reporting from time to time to the mechanical department any defects that may develop, with the idea of having the design changed in the next lot of cars built. A great improvement in the quality of repairs made to freight cars would be apparent in a very short time, if the men in charge were at all times near the work, giving it their close personal supervision instead of being obliged to spend so much of their time attending to office duties which should be handled by others.

BY H. H. HARVEY
General Car Foreman, Chicago, Burlington & Quincy, Chicago

The writer will only attempt to call attention to some of the little things that are so frequently overlooked as cars pass over repair tracks. Following are some of the things that should be done to every system freight car:

Inspect all brake hangers, pins, brackets, rods and levers and replace any defective ones. See that all brake pins are provided with good cotters or split keys, with both members well spread. See that the brake beam safety bars are securely fastened to the spring plank.

Inspect the journal boxes, brasses and wedges and remove worn or broken ones. When wheels are changed care should be taken to see that the tops of the boxes are not worn on the inside and that the backs of the wedges are not worn flat. Dust guards should always be looked after when the wheels are changed. Give the journal box packing the needed attention. See that the journal box and column bolt nuts are tight and secured with cotters, split keys, nut locks or lock nuts.

Give the hand brakes a thorough test. Have the safety appliances throughout the car thoroughly inspected. Test the air brakes and give special attention to leaks. Test the air hose under pressure with soap-suds and remove any spongy hose. See that the angle cocks are properly located and set at the 30 deg. angle.

Gage the couplers and make the necessary changes. See that all carrier iron, draft casting and follower strap bolts are tight and that the nuts are secured with cotters, split keys, nut locks or lock nuts. See that the body truss rods are tight and the car has the proper camber.

See that the side door hasps are properly located to bring the front edge of the door up tight against the stop when the door is in the closed position. See that the lower brackets at the back end of the side doors are so located that the door cannot be pried over the bracket. See that the side door tracks are tight.

See that the ends of box cars are grain tight, special attention being given to the small openings around the end posts. See that the sheathing under the corner bands on box cars is well nailed. See that the sides of box cars are grain tight at the posts and braces. If the car has a steel underframe, care should be taken to see that the side sill nailing pieces are not split or decayed. Have the floors in box cars grain tight. Narrow flooring in box cars is preferable to prevent undue shrinkage. Oakum will be found satisfactory for calking cracks in the floors.

Inspect refrigerator cars from the inside with the doors closed to detect small openings around the side doors and hatch covers. These openings should be closed before the car is permitted to leave the repair track.

Give the dump door mechanism on gondola cars special attention to see that it is in good working condition and that no small bolts, pins, cotters, etc., are missing.

If the items mentioned are handled as outlined, it will result in much good and add very little to the maintenance cost of freight cars. Foreign cars will also require more or less attention as to these details, but as a general proposition cars reach their home rails often enough for the owner to take care of most of the parts mentioned.

DISCUSSION

F. H. Hanson (N. Y. C. West): Both of these papers contain excellent ideas that we should all think about. We all know that some of the larger railroads are spending a great deal of money for additions and betterments in putting steel under-frames under cars, and using good, substantial draft gears, metal roofs and metal ends, and that they are inclined to put on doors that will cause the least trouble as well as protect the load; it is to be regretted that other roads are not doing this. The railroads that are doing this class of work are compelled to handle the cars of other roads that are spending very little money to put their cars in shape. The only solution of the problem seems to be for the railroads having the good equipment to tighten up on their inspection to protect themselves. Some of the trains have as many as 125 cars. With the class of equipment that gets in those trains we are having heavy expenses in making repairs which should properly be borne by the owners, as the damage, as a rule, is caused by a weakened condition of the equipment, and failure on the part of owners to properly maintain their cars. As the interchange rules now stand, I can see no other way for the lines that are spending this money to protect themselves except to tighten up in inspection.

T. J. O'Donnell (Buffalo): I want to emphasize the fact brought out in Mr. Justus' paper on the dilapidated condition of side doors. The owners of many cars make no attempt to maintain proper doors. Some have but two guides and they are out of line. Mr. Justus is in a position to know what should be done in the way of doorway protection. I think there should be united action to absolutely refuse such cars in interchange. Fastening up the doorway and taking the load away from it does not correct the evil. We have no less than 100 to 150 doorway orders—fixing up doors to try to overcome transferring the load. I think it an evil that could be corrected if every foreman and every inspector would make it a special point to take it up with the proper official and see if something could be done to get better doorway protection. The old type of door hanging is of no benefit now. The service is too severe. I heartily commend Mr. Justus' suggestion that four door guides of the deep type should be put on every house car door so that it will not get out of place should one of the guides happen to become lost.

J. J. Gainey (C. N. O. & T. P.): I heartily agree with both Mr. Justus and Mr. Harvey. The steel under-frame is the thing to put under a car. It is economy for any road and a step in the right direction.

F. C. Schultz (Chicago): It appears to me that the only method we could follow towards correcting this evil would be to work out a plan for a change in the rules by which a certain class of construction can be refused in interchange. I know of cases where we have had to transfer cars five or six times. Until we can work to a general standard we cannot solve the problem of handling such equipment.

H. Boutet (Cincinnati): Mr. O'Donnell's remarks on door guides are timely. At our interchange points we are bothered with the adjustment of side doors on account of the lading shifting. On some roads it is almost a crime for a delivering line to deliver a car with certain commodities unless the car is provided with doorway protection, but the same roads are loading cars at their own freight houses and along their own lines without any doorway protection and with the same commodities for which they require protection.

CAR DEPARTMENT APPRENTICES

(Second Prize)

BY C. N. SWANSON

Superintendent Car Shops, Atchison, Topeka & Santa Fe, Topeka, Kan.

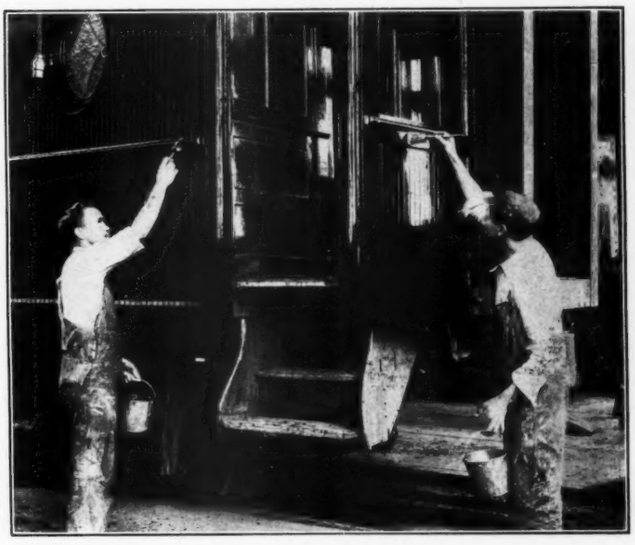
The question of men, the right kind of men, men by nature endowed and by training specifically fitted for the work they are called upon to do, is the biggest job the railroads and manufacturing concerns have to solve. In the struggle and competition of modern business push, brawn and muscle have necessarily given place to brains and skill. We must be "prepared" to meet the changing conditions. Nowhere is there greater need for "preparedness" than in the question of men. It is necessary that we select the right kind of young men, and definitely and specifically train them for our needs. Nowhere is there greater need for this than in the car department of our railroads.

The best form of an apprenticeship for any one company will depend largely upon each road's definite needs. Our car department apprenticeship system is a part of the elaborate, yet simple, system of apprenticeship which we have planned for the training and development of apprentices in the various trades, a system which has given us excellent results in the form of skilled journeymen, a system which has made it unnecessary for us to go outside our ranks for journeymen or for young men to fill our minor foremanships. The scheme has paid its way in dollars and cents even from the start.

APPRENTICE COURSES

Coach Carpenter Apprentices.—The course for our coach carpenter apprentices is four years in length, the boy starting out at $1 or $1.20 a day, according to locality, and being given a raise of 15 cents each six months. These apprentices are employed between the ages of 18 and 22. They are given nine months in the cabinet shop, nine months on outside coach body work, nine months on inside coach finishing work, six months on trucks, platforms, piping, and steel work, six months in the freight car shop, and the last nine months in the cabinet shop. Every variety of coach building work is given them, the schedule of work changing to meet the changing conditions. Throughout their apprenticeship they are given as broad experience as possible and upon graduation they are assigned to some particular class of work upon which they soon become experts. Should, however, the needs of the company require them for other work their preparation will have been such that they can easily and quickly adapt themselves to whatever work is assigned. We have had no need for several years now to go outside our ranks for coach carpenters. Several graduate apprentices have been promoted to positions of responsibilty and are making good.

Freight Car Apprentices.—Our freight car apprenticeship system has been in existance only about a year and a half. The boys are given a 2½ year course and a thorough experience, first on body work of freight cars, requiring light repairs; then on trucks, steel work, and air, and back again



Coach Painter Apprentices

on body work of cars undergoing heavy repairs. These boys start out at 16½ or 18 cents an hour, according to locality, and are given an increase of 15 cents a day each six months. This course has not been in operation long enough for us to have any graduates as yet, but already many of these boys are doing fully as much work and as good work as our regular freight car carpenters. As the freight car work is of a heavier nature than that required of the coach car carpenters, we have made the age limit from 19 to 30 years. The course has been made so thorough that we have had plenty of applicants, one college graduate having been attracted by the opportunities offered.

We also have an apprenticeship course for our coach painters, and another for our coach tinners and coppersmiths.

AN APPRENTICE SYSTEM

Supervisor of Apprentices.—Any apprenticeship system should be in charge of one efficient head, a supervisor of apprentices, who with his staff plans and directs the work for the entire system. This supervisor must possess qualities of leadership, be able to organize his department, select his instructors, and properly direct them in their work. He

must be able to adjust misfits, and must interest all the shop officers in the apprentices. He should have tact to carry out the necessary changes without friction or ill feeling. He must be a good mixer and know how to get what he goes after. He must be able to outline an efficient course of instruction and above all be able to inspire the best work of his instructors, and be of such a nature as to be heartily loved by all the apprentices. He must be an educator in the true sense of the word, for upon his head rests to a great extent the success of the enterprise.

Apprentice Schools.—We have apprentice school rooms equipped and maintained by the company wherein the boys are taught the theoretical part of their trade. These schools are in charge of technically educated men who have also a knowledge of a trade. The apprentices attend these schools during daylight hours on company time. Here they are taught to read a blue print and to make a working sketch. Our carpenter apprentices are taught arithmetic, including fractions and how to solve problems in board measure, how to make out a bill of material and to estimate the cost of various jobs; also the correct name and function of the various parts of a car, and other kindred subjects. The freight car carpenter apprentices are in addition taught the M. C. B. Rules of Interchange. In brief, each boy is taught everything that will help him with his particular vocation, but nothing that will detract him from that vocation. All the instruction in the school room is individual. Each boy progresses according to his ability. We have our own printer and printing press; prepare and print our own lesson sheets, these being issued to the various schools in loose leaf form so that they may be revised or added to as the occasion arises. The following are examples of what the apprentices are taught and some of the problems they are required to solve:

LESSONS IN LETTER WRITING

37. Write a letter of thanks to some one who has befriended you in some way.

38. Write a letter to the publisher of some railway magazine, ordering the magazine for a year and enclosing remittance for same.

39. Suppose an error was made in figuring your wages for last month. Write a letter to your head timekeeper asking him to investigate, enclosing with your letter statement showing number of hours worked each date.

INSTRUCTIONS REGARDING MATERIALS.

Wood is commercially divided into two general classes, hard and soft. With the hard woods we class oak, ash, hickory, berch, walnut, maple, etc. The soft woods are pine, poplar, chestnut, birch, etc.

Railroads use the following species of wood: Long leaf, loblolly and white pine; spruce, oak, ash poplar, bay wood, mahogany, maple, cherry and walnut. More pine is used than all other kinds combined. Oak is next in quantity.

PROBLEMS IN ARITHMETIC

1. An order for bolts reads as follows: 10 bolts 45 lb. each, 6 bolts 8 lb. each, 15 bolts 2 lb. each, and 3 bolts 2 lb. each. What is the total weight of the bolts ordered?

2. At 2 cents a pound, what would be the cost of the bolts on the above order?

3. A freight train takes 9 hours to go a distance of 153 miles. What is the average speed per hour?

446. How many square feet in the sides and ends of a box car 38 ft. long, 8 ft. 11 in. wide, and 8 ft. 4 in. high?

447. What would be the cost of painting the sides and ends of this car at 5 cents per square yard?

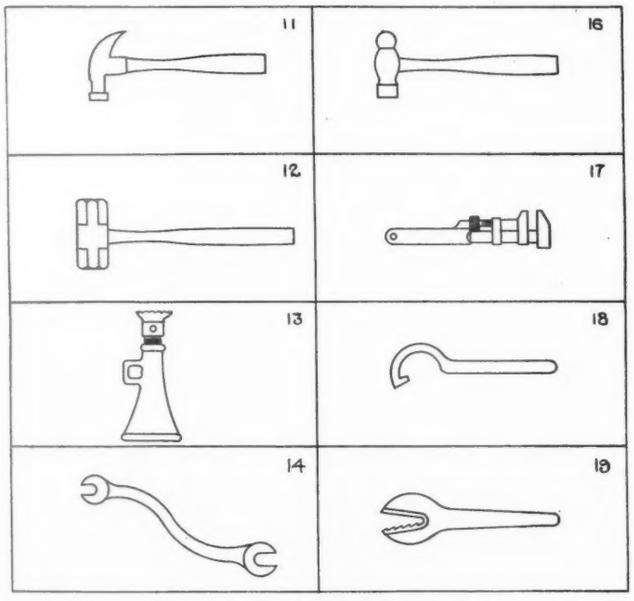
448. How many pieces of zinc 4 in. × 6 in. can be cut from a zinc plate 3 ft. × 6 in.? (The sign (×) as used above means "by.")

Shop Instructors.—Each master mechanic takes pride in showing his apprentice school room to visitors and in pointing out the good work of his boys. But proud as we are of our school room instruction we are prouder still of the work done by our shop apprentice instructors. The place to learn a trade is in the shop itself. As the men in our modern shops are so busy, we cannot trust our beginners to learn from them, so we have selected a competent mechanic for every 25 boys in the shop. He has no other duties than to instruct and look after the apprentices in his care. It is his duty to see that each boy gets a thorough training on each class of work and to arrange for his transfer from one class of work to another. He of course works in harmony with the foreman. Great care should be exercised in selecting these men for much of the success of an apprenticeship system depends upon the instructor. He should not have too many boys under his supervision. His duties are as difficult as they are important and as full of trials and hardships as of blessings for those whom he influences. He must be a keen judge of human nature, a man who is deeply interested in boys and young men, capable of taking a brotherly interest in their sports and pastimes, as well as in their work. He must be clean morally, must be just, impartial, and honest, must be firm and fair, must have patience and ability to instruct, must be able thoroughly to sympathize with each boy in his troubles and ambitions, and hold the friendship and confidence of each one. He must make an individual study of each boy and learn just what help each one needs and how this help can best be given. He must become familiar with each boy's home life, know with whom he associates, and how he spends his evenings, remembering that if the boys are to become good men and loyal mechanics they must also be honest and upright citizens.

Selection of Apprentices.—No system will produce results unless good material is selected to start with. So be careful in the selection of your apprentices. Since we are preparing

Apprentice Band, Atchison, Topeka & Santa Fe

men for a life-time of service, it is well to start with boys who are sound in body as well as in mind. Each applicant is required to pass an examination before the company surgeon, the examination being very similar to that required of applicants for life insurance. We also give the boys a school examination, the amount of schooling required depending upon the opportunities each boy has had. Of the boy who has had unlimited opportunities we expect much, but with the poor boy who has had to drop out of school to help support his widowed mother or little sisters, we make considerable allowance. In general, however, a boy who has reached the age wherein he may enter upon an apprenticeship, who has not yet learned how to add, subtract, multiply,



A Sample of the Sketching Required

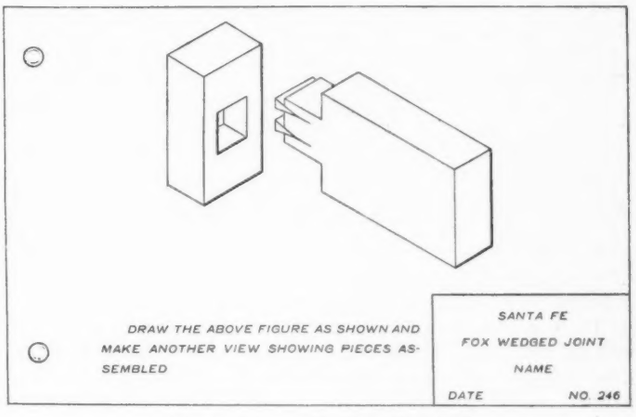
and divide, and handle simple fractions, is lacking in mentality or at least in ambition. We are also very insistent that no one enters upon work for which he has no natural fitness or liking. It is a crime to hold a boy in work for which he is unfitted, and it is a dead loss to the company to employ such an apprentice. We have plenty of applicants. Each boy employed is a living advertisement for us. When one boy is employed from any community we soon receive a number of additional applications from the same neighborhood.

Probationary Period.—Closely allied to the selection of apprentices is our probationary period of six months, during which time each apprentice is given every opportunity to prove his fitness. He is closely studied by our apprentice board which is composed of the general foreman, the department foreman, the gang foreman, the shop apprentice instructors, and the school apprentice instructor. Each month the members of this board are reminded that John Smith is a new apprentice and should be given special attention. At the end of the probationary period the apprentice board meets and jointly passes on the question of this boy's continuing on his trade. Sometimes they recommend his dismissal, other times they recommend an additional trial. If it is found that the boy should be a lawyer or a doctor or a merchant, and is unfitted to become a mechanic, he is kindly told that he is wasting his time in the shop, but the boy knows and his parents know and his friends know and the shop management knows that the partiality or dislike of no one man was responsible for this action.

Other Features.—These are the leading features, but there are many details. Each boy is required to have a specified set of tools, but these he may purchase at wholesale prices and if he prefers, by monthly deductions from his earnings. We have our apprentice baseball and football teams, our apprentice band and apprentice orchestra, apprentice clubs and social functions. When a man is needed for special duties some young man is selected according to his fitness, and given special training for this particular job. Just now we have several of our machinist and boilermaker graduates taking special training at the Baldwin Locomotive Works; likewise several car men at the shops of the Pullman Company. Just now we are sending some of our men to the Westinghouse shops and some painter graduates to the Pullman shops, the latter to become more familiar with the painting of steel cars, and particularly with the graining of steel work. So it goes. Nothing is too good for these boys who are to be the future journeymen as well as the future officials of the road.

RESULTS

Does the system pay? It certainly does. It pays in dollars and cents, in the added output of the shop even from the start. It pays much more in the number of skilled journeymen who are being prepared to recruit our depleting ranks. We would no sooner think of doing without our apprenticeship system than we would of doing without our power houses. We have a body of young men who are being thoroughly trained as to the methods in vogue on the Santa Fe and who because of their splendid treatment as apprentices are particularly loyal to the company. The kind and considerate treatment given the apprentices has had a wholesome effect on the entire shop body. The good feeling has been contagious and now permeates the other departments of the



Sample of the Drawing Required

shop. There is less of the old time raw-hiding and more recognition that a man is a man no matter what his position. We have taught our boys that the work of a carpenter is just as honorable as that of a lawyer or doctor, that all the brains of the country are not confined to the halls of congress or to Wall Street. It takes just as smart a man to be a good car man as to be a good merchant or banker. We teach these boys the joy of work, the true happiness of work, and that work is honorable and to be sought, not avoided. We teach them that education will not lessen their work but will increase their opportunities for work and service. All work is sacred.

The principal reason for the success of our apprenticeship system is that it has the unlimited support and backing of the management. Everyone from the president down is proud of the system, and ready to boost it forward. Without such backing it would be hard to install any system of this kind. The average railroad man is too proud of his prerogatives to work in harmony with any system which appears to lessen his authority, and for this reason it is very important, espe-

cially at the start, that the management be back of any scheme which has for its object results which will be more apparent in the future than in the immediate present.

HANDLING AND REPAIRING FREIGHT CARS

BY F. C. SCHULTZ
Chief Interchange Inspector, Chicago, Illinois

The care of the car, it appears, is governed principally by the demand that there is for the car. This policy prevails generally, although we must confess that it is not the right policy to follow, for in doing so the cars, when the demand is light, are neglected, the repair forces are reduced and the material supplies are allowed to get low. When business picks up again the cars are rushed to the shops, the forces reorganized, inexperienced men are hired, to say nothing of premium prices paid for material which is not always available, for the supply companies follow the same practice and allow their stock to become low on account of the lack of demand. It is claimed that the financial conditions of the railroads require that this policy be followed, but it is apparent that this practice has been changed by some of the strong lines within the last few years. It is now their policy to keep the repair forces at work continuously in order that the equipment will be in serviceable condition when it is required. When business is slack money is cheap and it would be good policy to raise the money at that time to repair the cars so they will be fit to use when business increases.

Joint Repair Shops at Terminals.—It is well known that the men in charge of car repairs do not take the proper interest in the repairs made to foreign cars, and this may be justified for the reason that as a general proposition they do not have adequate facilities for making proper repairs to their own equipment. Also they are handicapped in making repairs to foreign cars on account of the lack of the proper material and the fear of making wrong repairs to which the owner of the car may object. This results in cars being allowed to run with defects which should be repaired, and which soon put the car in an unserviceable condition. This is particularly true in a large terminal, and our present method of handling cars under the Car Service Rules is, to a measure, responsible for it. When a defective foreign car is loaded at a terminal, unless it is loaded for the home line, it comes back to the loading point and is continually reloaded until it becomes unserviceable. It is then reported to the car owner and invariably the owner requests that the car be repaired. Many times the car is on a small terminal line, which has no facilities to make the extensive repairs the car may require. For this reason it has been my thought and argument for some time past that at large terminals joint facilities should be created to take care of the foreign cars, not only when they become unserviceable and in a condition to be reported to the car owner, but immediately when they are found to be in need of repairs. Every car foreman would consider it a blessing to be able to send such cars to a joint shop. He could then confine his efforts and resources to repairing his own cars, and far better results would be obtained for all concerned. Car repairers working on a home car will do a more thorough job as they are more familiar with its construction and the material required than they are with the foreign cars. If repairs to foreign cars could be confined to one or more localities in a large terminal, for this reason far better results would be obtained.

Inasmuch as it is the custom to load cars back to the point from whence they came, unless they are loaded home, which is not generally the case, it would appear that by the creation of adequate car repair facilities at large terminals there would automatically be an adequate supply of cars in good condition at such terminals. I have personal knowledge of cars that have stayed in large terminals as long as two years and nobody heard from them until they got into bad order. The question of joint facilities has been studied sufficiently to satisfy us that it is entirely feasible; and transportation men agree that the per diem and switching charges can be taken care of readily. The question as to whether or not the prices quoted in the M. C. B. rules are adequate to sustain such shops is still open, but if they are not they should be increased so that the repairs to foreign cars can be made profitable to the parties making the repairs. The management of these shops should have authority under the M. C. B. rules to charge the car owner or the delivering line, as the case may be. The repairs should be made and inspected under joint supervision and the bills rendered in accordance with the M. C. B. rules, the switching and per diem charges being rendered against the line responsible for the repairs.

Routing Foreign Cars Home.—I wish to call attention to what, in my mind, is a very material defect in our M. C. B. rules. I have in mind the second paragraph of Rule 3, which now states "Empty cars offered in interchange must be accepted if in safe and serviceable condition, the receiving road to be the judge. Owners must receive their own cars, when offered home for repairs, at any point on their line, subject to the provisions of these rules." This rule should be amended so that railroads must receive foreign cars which have home rights over their line, and dispose of them in accordance with M. C. B. rules. This change in the rule is fully justified, especially at large terminals where the points of interchange are anywhere from one to 25 miles apart. It appears that the M. C. B. rules are framed with the thought in mind, that the interchange of cars always takes place upon adjacent tracks. This is not a fact and for this reason the above change should be made. Some car men object to this, saying that if the rules were so changed it would result in neglect to equipment and that the railroads would dump upon each other all such cars after they had become in bad order and expect the home route line to handle them. This is true, and, to my mind, under the present conditions and especially at large terminals, it is fully justified. Further, we should not go to the expense of making technical inspections of empty foreign cars routing home, but should allow them to take the regular course, the same as the home car, and when they reach the trunk line over which they have home rights they should be accepted by that line and disposed of in accordance with the M. C. B. Rules.

Further objection has been raised for fear that cars may be delivered in interchange with penalty defects, or otherwise not safe to handle. This objection is without grounds, for cars with penalty defects are not now being interchanged and the cars that would reach such home route connections would be safe to handle. Of course the cars may require such repairs as ends, roofs and sills which could be made by the home routing line and the car placed in service. From my experience at a large terminal I am unable to justify the return of a car in an opposite direction from home from any point of view, and I hope that at some future time some rule will be formulated which will prohibit this. In event it is, some method of compensating the road required to haul a car in this manner, and which has not enjoyed a loaded haul, should be worked out. I trust that our members in making suggestions for changes in the rules in future will bear this in mind. No rule today that has a penalizing feature is justified. There are sufficient requirements made by the state and federal governments and local authorities to keep the cars in proper condition without resorting to penalties.

Uniform Interchange Methods.—In interchanging cars there is also a great deal of variation in the manner in which the M. C. B. Rules are followed, and particularly is this so at large terminals. I can see absolutely no excuse for this,

for a rule that can be worked in one large terminal can be worked in the other. The lack of co-ordination between the committees handling interchange problems at the various interchange points is responsible for this. To remedy this condition I would suggest that one general supervising body be created, whose duty it would be to see that all terminals are operated uniformly. An excellent example of the injustice of the present practice can be seen in the various modifications that are in effect in the handling of loads under A. R. A. Car Service Rule 16. If it is not practical to create one general supervising body it might be well to hold a meeting of the interested parties at the various large terminals each year and adopt a set of rules which will and can be carried out uniformly.

M. C. B. BILLING AND REPAIR CARDS

To appreciate the importance of M. C. B. billing in railroad work one must take into consideration the number of cars involved. D. R. MacBain, president of the M. C. B. Association, in his opening address last June, called attention to the fact that the members of the association represented 2,853,482 cars. To give some idea as to the extent cars are off the owner's line, one large railroad owns approximately 5,000 cars more than the average number of cars handled by it, but in spite of this, between 50 and 65 per cent of the cars handled are foreign cars.

There are various methods in which the information for the bills is obtained. Some cars require only very minor repairs, while others require repairs of an extensive nature; therefore one road is very likely to use two different forms on which the original record is taken.

A card form is ordinarily used by one who is termed a repair work inspector to indicate to the repairmen the repairs to be made and provides for such information as the car number, initial, class of car, whether loaded or empty, date, and space for itemizing the repairs to be made and the cause. Often other information is contained on the card, such as the date the car was carded to the repair track, the date and time it was placed on the repair track, the date and time the repairs were completed, and the date and time the car was released for service. After repairs are completed the information as to the kind, size and weight of the material is entered either by the repair work inspector or by one who is termed a material checker. A material checker is very essential in a large organization to insure the proper information being recorded, also to ascertain as to whether or not the repairs are properly chargeable to the owner.

On some roads it appears to be the practice for the repair work inspector or material checker not only to fill in this kind of a card, but to make what is commonly known as an M. C. B. billing repair card; also to make the extensions as to the size of the material, the kind, weight, feet of lumber, etc., and the number of hours chargeable in accordance with the M. C. B. rules. Other roads only require the repair work inspector or material checker to furnish information as to the repairs and the size of material used, and clerks at the shops are required to fill in the billing repair cards, make the extensions as to the weights, number of feet of lumber, hours of labor, etc., chargeable.

Each of these systems has its advantages. The repair work inspector or material checker is more familiar with the car and, therefore, more likely to enter the information correctly; also if he is required to enter the information there will be a tendency to be more careful to see that all the material used is charged, and, as it necessarily involves more direct application of the rules, there is less liability of erroneous charges being made. The advantage in having clerks fill in the billing repair cards, and likewise make the extensions as to the charges under the M. C. B. rules, is that all such men's time would be required to compile the information and they would become expert, consequently giving a greater output. Also it is the entering wedge for making of the future inspector, foreman, or M. C. B. billing clerk in general offices or accounting departments.

There is still another system in use where all the billing repair cards are properly filled in as to the kind and size of the material used, after which the cards are sent to some central office where clerks make the material and labor extensions and prepare the card preparatory to making out the bill.

After the billing repair cards have been properly filled out and contain the essential information for billing purposes, they are sorted by roads alphabetically. On large roads clerks are assigned to handle certain railroad companies' bills which they render each month. The advantage in this system is that such clerks become more familiar with the initials and class of cars of the various roads for which they prepare bills, and in this way errors are avoided. After the billing repair cards have been prepared and sorted according to roads they are then written up on M. C. B. billing form either in longhand, typewriter or by a special machine which has been constructed for the purpose. The advantage of using machines, where the amount of work warrants, is that after the bill has been written it has also been computed, and there is also much less likelihood of errors being made in extensions.

Two general methods prevail in checking the bills. In one the bills of the foreign roads are checked in the same office that renders the bills, whereas in the other the bills are checked by a different organization entirely. The only advantage the one has over the other is that if clerks are assigned to check bills of the roads for which they have been assigned to render the bill a more uniform manner of billing and checking prevails and the possibility of contentions can be averted, as the billing clerk knows in the preparation of his charge that under the same condition the road against which he is preparing the bill would probably prepare a similar bill.

The best methods to bring about accuracy in making bills are to have a system of surprise checks, either by one delegated exclusively for this purpose, by a division officer when making his periodical visits, or, at the direction of the division master car builder or master mechanic, by having the material checkers or M. C. B. billing clerk at one station check up another station, and report to the head of the department any discrepancies noticed. If either of these practices is followed good results will be obtained.

The work can be facilitated by the least complicated system, but any system is a failure unless it is properly supervised. A man usually adapts himself to a system that prevails at the point where he is employed, and if a bad practice prevails, there is no means of correcting him, whereas if there is a general supervising officer who could devote his entire time to this work, he could harmonize the various practices. He could see that the M. C. B. rules and instructions which are issued from time to time are fully understood and complied with.

The report was signed by J. V. Berg (N. Y. C.), chairman, F. A. Eyman (E. J. & E.), and F. A. Rawley (D. & R. G.).

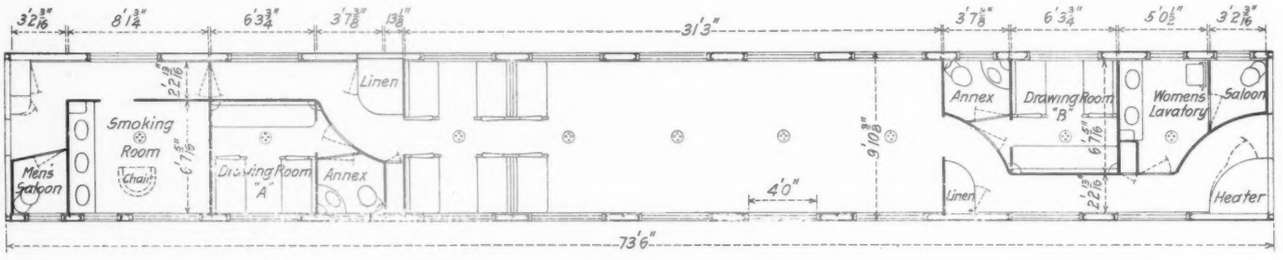
HARDENING WITH THE OXY-ACETYLENE TORCH.—Gear teeth may be hardened by playing the welding flame along the face of a tooth, and then allowing the heat to be conducted away by the body of the gear. The intense heat of the flame permits of a single tooth being heated very rapidly before much heat is conducted to the rest of the gear. As soon as the flame is removed the heat in the treated tooth is conducted away to the body of the gear. This causes hardening of the tooth. This operation is repeated until the desired depth of hardening is reached.—*Welding Engineer.*

CANADIAN GOVERNMENT SLEEPERS

All-Steel Except Part of the Interior Finish; Cars Have 10 Sections and a Weight of 168,500 Lb.

THE Canadian Government Railways have recently placed in service 12 all-steel sleeping cars, eight of which were built by the National Steel Car Company, Hamilton, Ontario, and four by the Preston Car & Coach Company, Preston, Ontario. Each car has 10 sections and two drawing rooms and conforms to the following principal dimensions:

Length over end sills	73 ft. 6 in
Length between truck centers	57 ft. 6 in.
Length over buffers	82 ft. 6½ in.

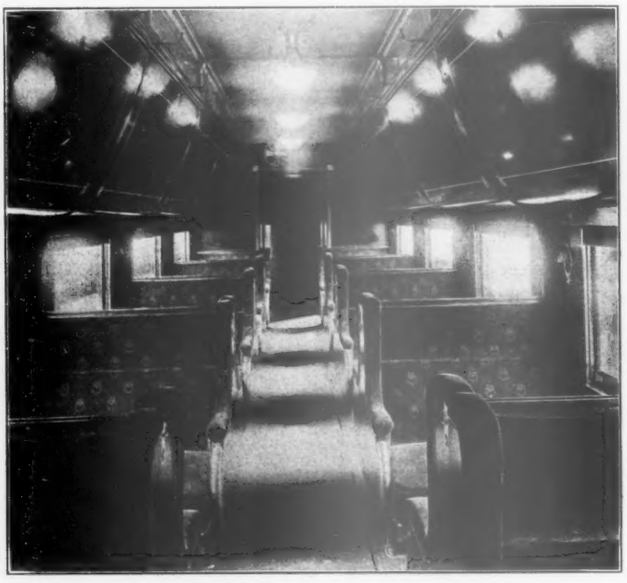


Floor Plan of the Canadian Government Sleepers

Width over side sills	9 ft. 10 in.
Height, rail to top at center	14 ft. 2 in.
Trucks	Simplex, six-wheel
Journals	5 in. by 9 in.
Total weight, complete	168,500 lb.

UNDERFRAME

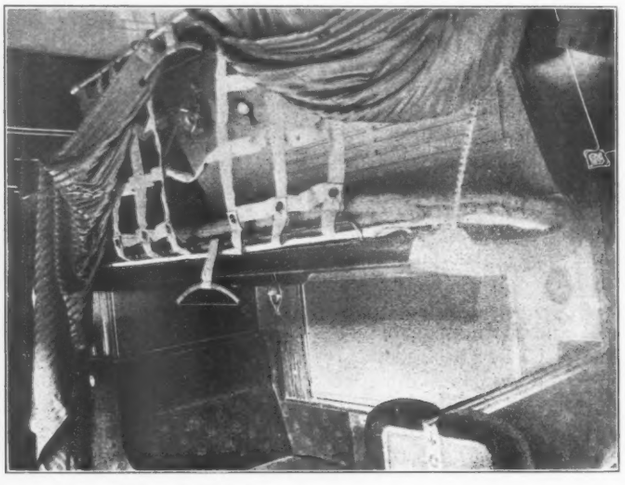
The underframe is of the through center sill type. The sills are 15-in., 40-lb. channels, spaced 16 in. apart, with the flanges turned outward and extending from buffer to buffer. A single ⅜-in. cover plate is riveted to the bottom flanges, extending to a point 3 ft. 10 11-16 in. beyond the center line of the transom at each end of the car. The top flanges of the sills are re-inforced with two cover plates, the first a 5-16-in. plate extending the entire length of the sills and the second, a ¼-in. plate 24 ft. 9 in. long.



Interior of Canadian Government Sleeping Cars

The transoms are built up of two 5-16-in. pressed steel web members on each side of the center sills. These are spaced 9 in. apart, and have full length top and cover plates tapering from a width of 24 in. at the center to 15 in. at the ends. The top cover plate is ⅝ in. thick and the bottom plate ⅞ in. thick. A steel filler casting is placed between the center sills above the center plate. In addition to the transoms there are four single-diaphragm cross ties, the webs and fillers of which are 5-16-in. pressed steel, the top and bottom flanges being re-inforced with ⅜-in. and ½-in. cover plates, respectively, each 6 in. wide and extending across the car to the 6-in. by 4-in. by ½-in. angle side sills.

The body and end sills are ⅜-in. pressed steel, re-inforced at the top by a ½-in. plate, 10 in. wide where it crosses the center sills, and tapering to a width of about 3 in. at the end. The platform end sills are made in three sections, the center section being an 8-in. by 8-in., 34-lb. H-beam and the ends built up of structural and pressed steel sections.

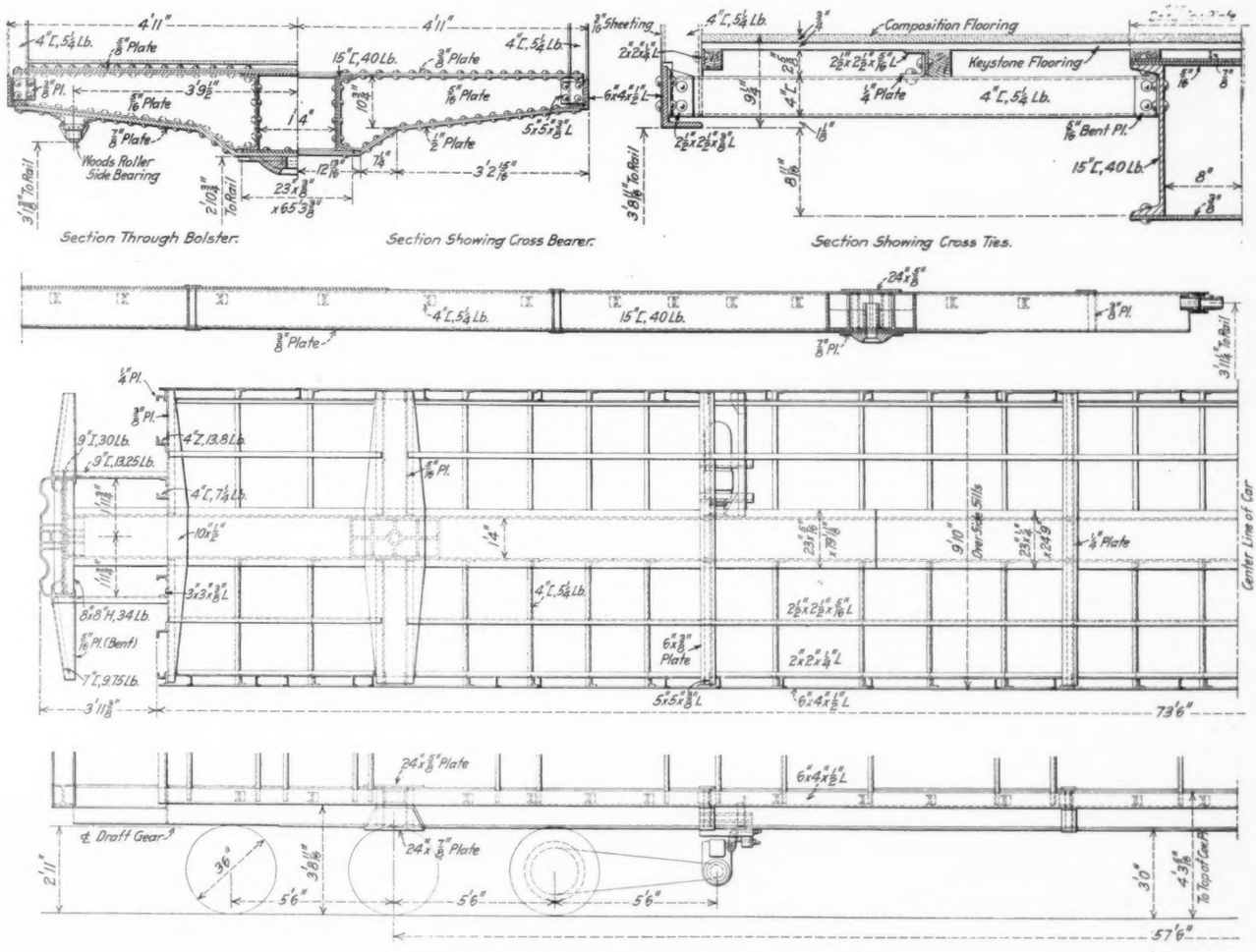


Upper Berth Safety Straps and Coat Hangers

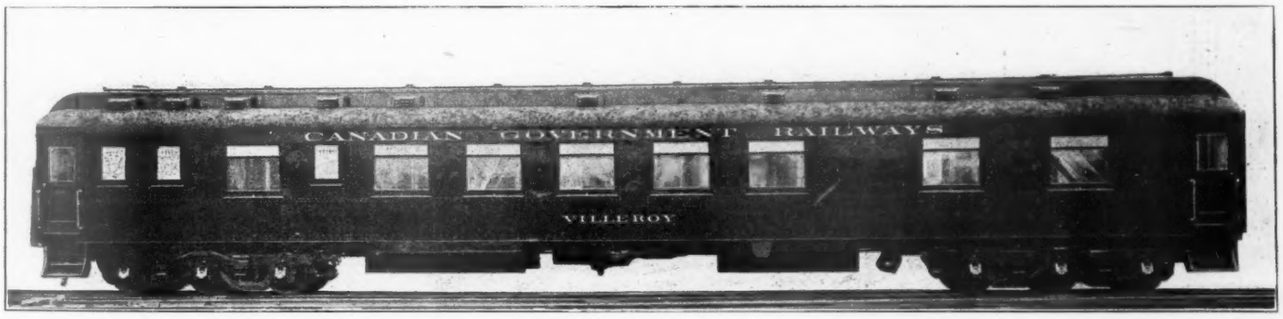
Platform end posts of 9-in., 30-lb. I-beams are framed between the sections of the end sills, the attachment to the H-beam being made by means of corner plates of 5-in. by 3-in. by ⅜-in. angles. The intermediate platform sills are 9-in., 13.25-lb. channels, and are attached to the body and platform end sills with 3-in. by 3-in. by ⅜-in. angle corner plates.

The floor supporting system consists of transverse 4-in., 5¼-lb. channels, spaced from 2 ft. to 3 ft. 6 in. apart.

These channels are attached to the side and center sills by means of angle corner plates and carry the intermediate longitudinal floor supports. These are wood strips re-inforced at the top with 2½-in. by 2½-in. by 5-16-in. angles. the spacing being arranged to suit the window openings. The belt rail is a ½-in. by 4-in. bar, riveted to the outside sheets. The top of this bar is 2 ft., 11 in. above the bottom of the side sills and to it is riveted a light 2-in. by 4-in. angle


Section Through Bolster.
Section Showing Cross Bearer.
Section Showing Cross Ties.
Underframe Arrangement and Details of Construction

The side supports are a 2-in. by 2-in. by ¼-in. angle, riveted to the inside flange of the vertical side frame members. Both longitudinal angles are fitted with wood nailing strips and the floor is supported at the center on nailing strips placed directly over the flanges of the center sills.



Canadian Government Railways 10-Section Steel Sleeper

BODY CONSTRUCTION

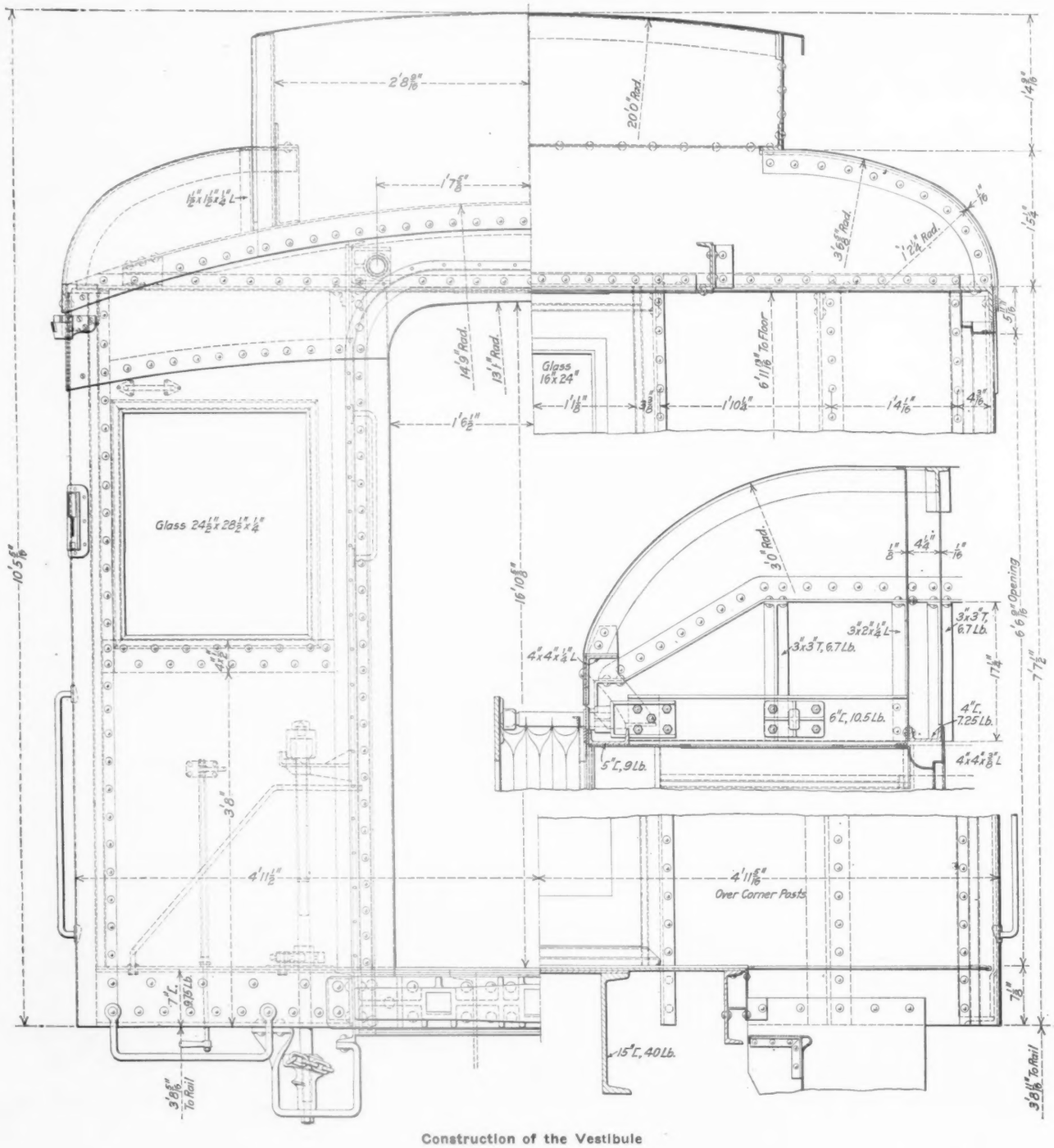
The principal members of the side frame are the 4-in., 5.25-lb. channel posts, extending from side sill to the plate, with the long leg horizontal, the wood window sills being attached to this with round headed wood screws.

The sides of the car are covered with 5-16-in. sheets, applied in panels, those below the windows being applied first. The sheets between the windows extend under the bottom of the letter board which is a ¼-in. plate, 13 in. wide, the top of which is placed flush with the top of the side plate angles.

The roof is of unusually light construction. The lower

deck carlines are 3-in. by 3-in. by 6.7-lb. T-iron, to the flanges of which the roof sheets are riveted. The deck sheets are flanged at the top to form an inverted U-section 2⅞-in. wide and are secured at the bottom to the vertical leg of a 3-in. by 3-in. by ¼-in. longitudinal angle, which is riveted to the ends of the lower deck carlines. The deck sheets are stiffened vertically by T-irons, which are applied on the outside of the deck plates. There are 15 of these on each side of the car, the intervals between them being considerably greater than those between the carlines. The upper deck carlines are 3-in. by 3-in. by 6.7-lb. T-sections, the flanges of which are bent down at the end and riveted to the inside faces of the deck sheets. The roof sheets, which are 1-16-in. thick, are riveted to the carlines; they extend over and are also riveted to the inverted U-section at the top of the deck sheets.

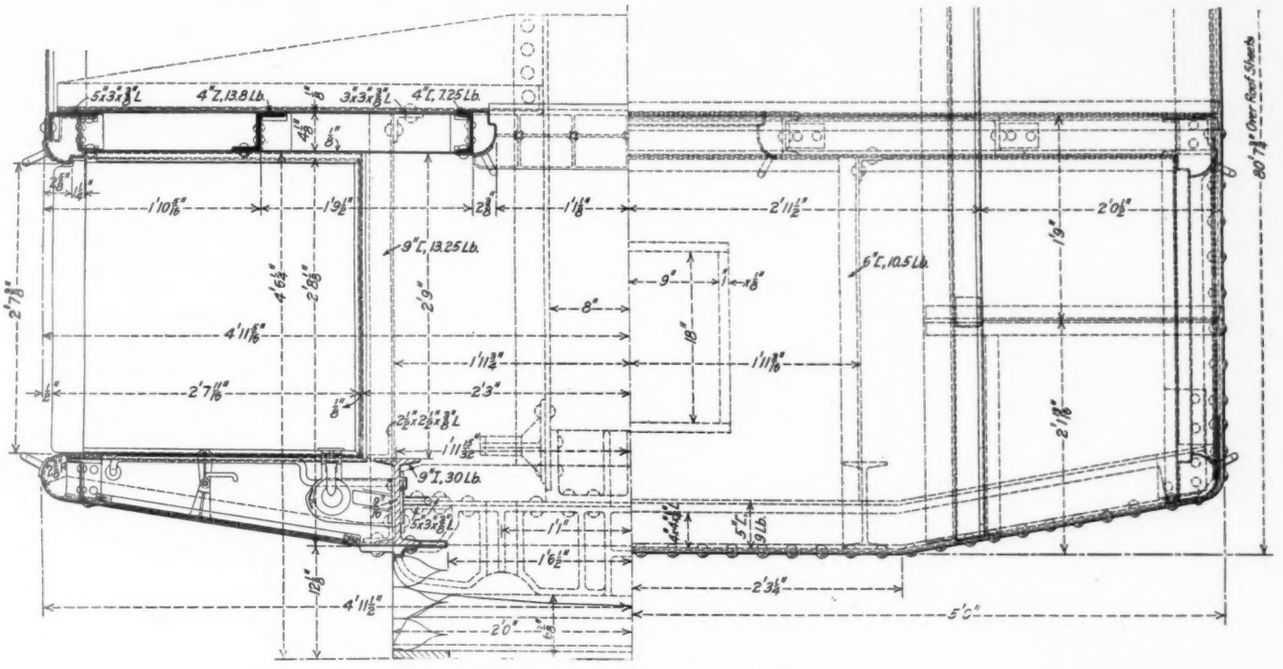
The details of the vestibule and body end construction are clearly shown in the drawings. The body end-frame members are the 4-in., 7.25-lb. channel door posts, the corner posts built up on 5-in. by 3-in. by ⅜-in. angles, and the 4-in., 13.8-lb. Z-bar intermediate posts. The short leg of the corner post angle is flush with the outside face of the side sill and to it is riveted the side sheet. The face of the long leg is even with the inside faces of the intermediate and door posts and to it is attached the ⅛-in. steel interior end finish. The corner post is completed by a special ¼-in. pressed steel



Construction of the Vestibule

channel, to which the exterior end sheet is riveted and is finished with a pressed steel vestibule door post, applied outside of the side and end sheets. The hood construction is designed for longitudinal rigidity and is simple in its detail.

a portion of the webs of the I-beams are continued upward and to them are attached longitudinal 6-in., 10.5-lb. channels extending to the bulkhead at the end of the car body, where they are secured with angle corner plates. These



Horizontal Section Through End Frame and Half Plan of Hood

The end stresses are carried across to the sides of the car by channel-section vestibule and body end plates. A 5-in., 9-lb. channel is placed across the top of the vertical 9-in. I-beam anti-telescoping members, flanges upward. This is

Interior Finish of Women's Lavatory

bent to conform to the contour of the end of the vestibule and is secured at the ends to the angle side plates, which are continuous to the ends of the vestibules. Inside this channel, channels carry the top diaphragm buffer spring brackets. Longitudinal stiffness at the bulkhead is secured by the use of a 4-in., 7.25-lb. channel, placed with flanges up, the ends of which are attached to the side plates. To the inside of this channel is riveted the 1-16-in. steel interior finish, and to the outside is riveted the ⅛-in. plate reaching from the top of the door to the roof. It is applied in two pieces, which are flanged and riveted together on a horizontal line even with the top of the lower deck. The vestibule and roof sheets are riveted to a 4-in. by 4-in. by ¼-in. angle, which is shaped to conform to the curve of the end of the roof and is secured at the ends to the horizontal channel member by the use of pressed steel fillers.

INTERIOR FINISH

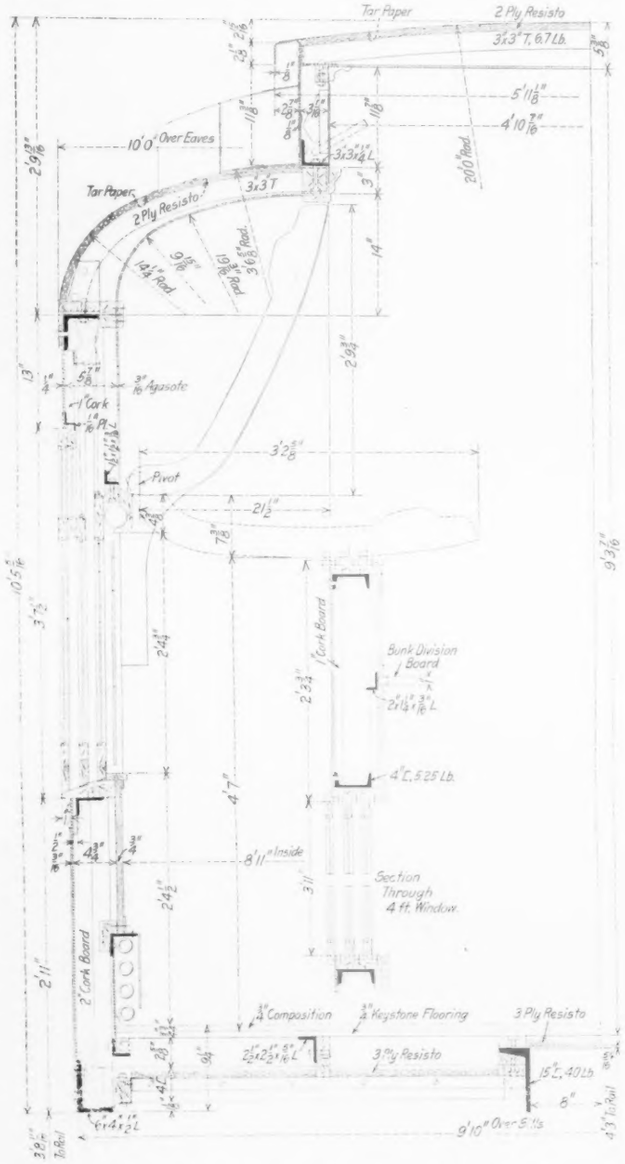
The floor is laid with ¾-in. Keystone flooring, above which is applied ¾ in. of composition. The sides, below the table plate over the steam pipes, are ⅛-in steel plates, which are lined on the exposed side with ¼-in. asbestos board extending from the top of the Keystone flooring to the table plate rivets. The wainscoting, the window sills, window stops and wall plate moulding are wood while the sides above the windows and the lower deck ceiling, which are enclosed by the upper berths, are of 3-16-in. Agasote. This material is also used for the upper deck ceiling, but in the latter case is ¼-in. thick.

The cars are well insulated, Corkboard and Resisto being the principal materials used. An air space below the floor is enclosed with sheet metal covers flanged and screwed to wood strips and lined with three-ply Resisto; the tops of the center sills are also covered with the same material. The outside sheets below the windows are lined with Corkboard, 2-in. thick, and 1-in. Corkboard is applied between the windows and inside the letter board. The roof sheets are lined with ⅛-in. tar paper, which is cemented on, and they are further insulated by the application of two-ply Resisto. For winter use, the window openings are fitted with storm sash,

which are hinged to open outward for convenience in cleaning.

The interior finish of the body is in vermilion, the steel work being grained in imitation wood. The drawing rooms are finished, one in Cuban mahogany, and the other in English oak, while the smoking rooms and passageways are finished in Koko. The women's lavatory is finished in white enamel and vermilion and the walls of all saloons are covered with 3/8-in. glazed tile, imbedded in cement applied to expanded metal lath.

The cars are fitted with the Stone electric light system.



Cross Section of the Car Body and Horizontal Section Through the Windows

The lighting fixtures are of the semi-indirect type placed on the center line of the upper deck ceiling. Both the upper and lower berths of each section are fitted with reading lights.

TRUCKS

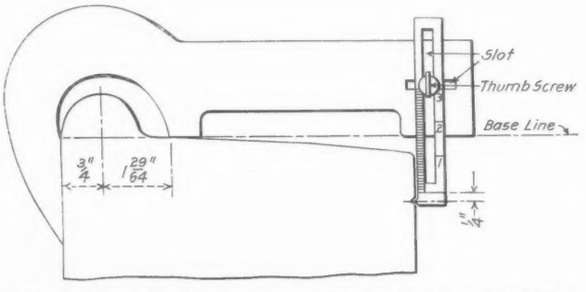
The cars are carried on Simplex six wheels trucks, with a wheel base of 11 ft. The frame of this truck is of the built-up type, in which both structural and pressed steel sections are used. The side frames are of box sections, formed by the use of two 8-in. channels, placed with the flanges adjoining and covered on top for the greater part of their length by the gusset plates which form the top flange of the transom members. The center plate and longitudinal bolster is an integral steel casting, which is bolted to the built-up transverse bolsters. Woods roller side bearings are used and the trucks secured to the car body by Coleman locking center pins. The trucks are fitted with clasp brakes.

Among the special appliances with which the cars are fitted may be mentioned the Miner friction draft gear and buffing device, the Chaffee drawbar centering device, the National steel trap doors and McCord 5-in. by 9-in. journal boxes. The windows are fitted with Edwards sash fixtures and weather stripping and the curtains are of silk finish Pantasote. Garland ventilators are applied to the deck sash. The Gold car heating system is used, and the equipment includes the Frumveller double duplex coil heater.

GAGE FOR STEEL WHEELS

BY C. E. STRAIN
General Foreman, Hocking Valley, Logan, Ohio

Considerable trouble has been experienced in finding a convenient method for determining the amount of service metal on steel wheels, such as is required by M. C. B. Rule 10. The gage shown in the illustration has been found very useful and gives the desired information without any computation and with sufficient accuracy. As indicated, the gage is placed perpendicular to the tread of the wheel and at right angles to its face by pressing the straight edge on the inner side flush against the face of the wheel. The projection on



Gage for Determining the Amount of Service Metal on Steel Wheels

the horizontal part of the gage will rest on the tread of the wheel at a point on the base line of the wheel. The slotted scale is adjusted by putting the small projection on the lower end into the witness groove, and is held in place by tightening the set screw. The gage may then be removed and the amount of service metal determined from the scale. The figures on the scale start 1/4 in. above the small projection which fits into the witness groove. This gage may be easily carried in the pocket and the information can be obtained by its use more conveniently than by means of calipers.

Self Lubricating Metal.—A self lubricating metal is described in the Scientific American, in which the mechanical strength of graphite is increased by impregnating it with a metal. The mixture is called "Graphalloy," and is not injured by contact with oil. The graphite is placed in a crucible of the same material, together with the molten metal, with which it is to be impregnated. The crucible is then placed in the cylinder of a large press, and a partial vacuum created simultaneously with the application of heat. Upon the completion of this operation high-pressure air is admitted to the cylinder of the press. The plunger of the press on which rests the crucible is also forced up by hydraulic pressure. After impregnation the graphite is found to have absorbed metal enough to increase its original weight by 150 per cent. For bearing purposes the alloy used is babbitt.

Shop Practice

OXY-ACETYLENE WELDING IN BOILER REPAIRS

The Atlantic Coast Line has, to a very large extent, discontinued the practice of riveting fire box seams in locomotive boilers, and instead is welding these seams by the oxy-acetylene process. The only riveting that is done is through the mud-ring. By following this practice the cost of manufacture and the cost of firebox repairs is materially reduced. The method of applying new fireboxes to wide firebox engines is also greatly simplified. The new firebox is made in three pieces, namely, the side and crown sheet (in one piece), the door sheet and the tube sheet. Four or five new fireboxes are made at one time for certain classes of engines and held in stock to be used as needed. This work is all done with templates and the fireboxes are fitted to a standard mud-ring as shown in Fig. I. The tube sheet is welded in (the weld is painted white in the illustration to bring it out more clearly) and the door sheet is clamped in position. The flanges on the tube and door sheets are flanged cold to a radius of 7/8-in. This work is done in a 250-ton section flange press.

The old firebox is removed by the oxy-acetylene cutting process, and the boiler is lifted from the frames and dropped on to the new box. The mud ring is put in place and the firebox secured so that the boiler can be replaced on the frames thus giving the other workmen an opportunity for doing their work. The mud ring is riveted in place, the staybolts applied, the door sheet welded in, and the crown bolts applied. Fig. 2 shows the door sheet partially welded in. On the narrow firebox engines the fireboxes are applied in five pieces and without removing the back head or the mud ring, and leaving the boiler in position on the frames. These pieces are the two side sheets, the tube sheet, the crown sheet and the door sheet. It will readily be seen that by this practice a large amount of time and labor are saved with an

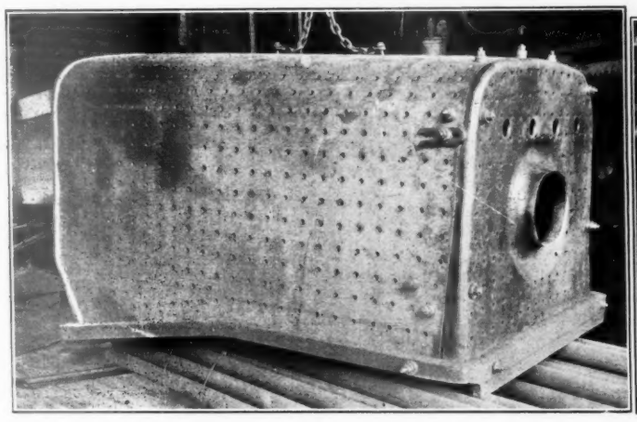


Fig. 1—New Firebox Ready to Be Applied to the Locomotive Boiler

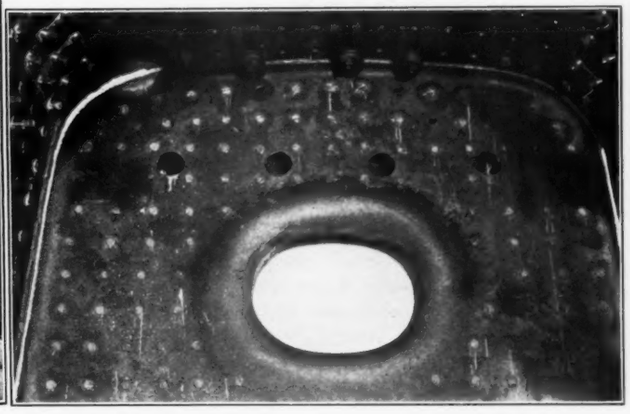


Fig. 2—Door Sheet of New Firebox Partially Welded In

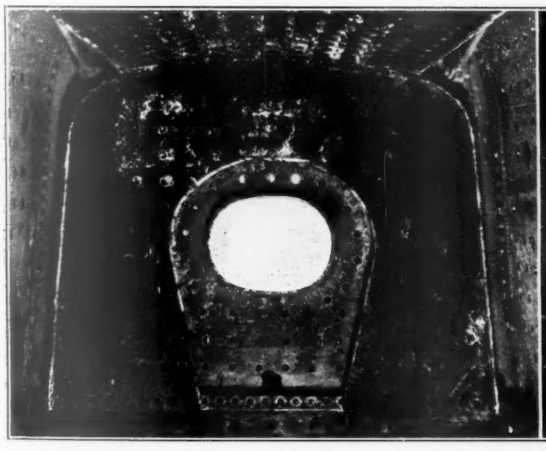


Fig. 3—Firebox to Be Welded by Oxy-Acetylene

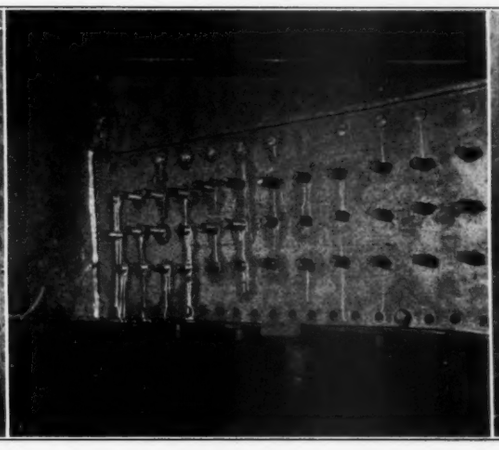


Fig. 4—Side Sheet Patch

Fig. 5—Firebox Corner Weld

accompanying decrease in cost. This work has been done in this way for some time and has given very satisfactory results.

In applying patches to the fireboxes the oxy-acetylene welding process has also been found most satisfactory. Fig. 3 shows the interior of a firebox to which new side sheets and a part of a door sheet have been applied. The scrapped sheets were cut out by the oxy-acetylene process. Fig. 4 shows a new lower section of a side sheet in place ready for welding. It will be noticed that the staybolts are applied before the welding is done. Fig. 5 shows a weld in the front corner of a firebox between the side and door sheets. In this particular boiler considerable trouble was experienced with the flanges on the door sheet cracking out from the rivet holes. The door, side and crown sheets were cut through at the rivet holes and welded. Fig. 6 illustrates a crown and tube sheet patch made by this method and Fig. 7 shows a front tube sheet which has been partially cut away and is about to be repaired.

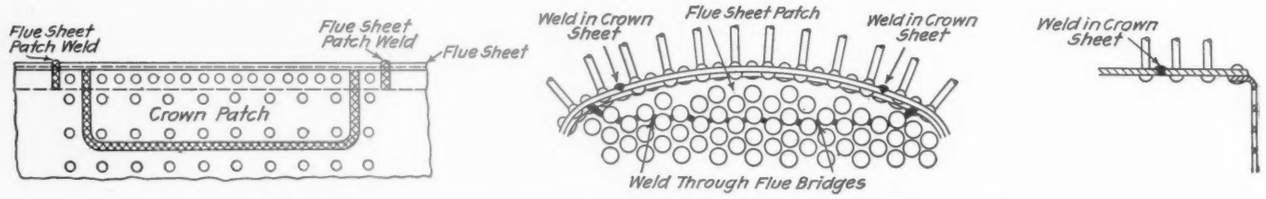


Fig. 6—Crown and Tube Sheet Patch Made by Oxy-Acetylene Welding Process

While many other roads have used this method of making boiler repairs the practices above described concerning the application of new fireboxes are, at least, unique to a large number. The saving in cost of labor and the reduction in the time an engine is held for such repairs is an attractive feature of this work. The Atlantic Coast Line also welds the tubes in the back tube sheet by the electric welding process. The tubes are set up in the usual manner before they are welded. If leaks occur they are lightly caulked but not rolled. By following this practice a night boiler maker has been eliminated. The information for this article was obtained through the kindness of R. E. Smith, superintendent of motive power; D. M. Pearsall, shop superintendent, and L. M. Stewart, boiler foreman at the Waycross, Ga., shops of the Atlantic Coast Line.

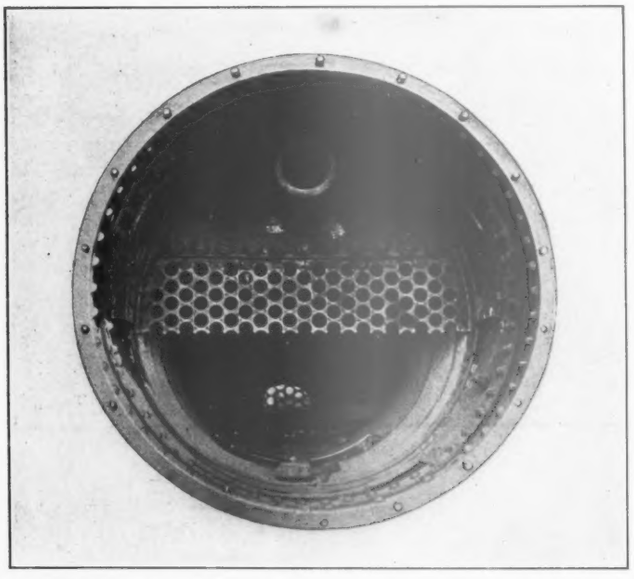


Fig. 7—Tube Sheet to Be Repaired by Oxy-Acetylene Welding

A LOCOMOTIVE AXLE FAILURE

H. W. Belnap, chief of the division of safety, Interstate Commerce Commission, has recently reported on the locomotive axle failure which occurred on a 10-wheel locomotive on a road in the middle west and which resulted in the death of the engineer. While the locomotive was traveling at a speed of 25 m. p. h. the left main driving wheel came off, stripping the engine on both sides. The engineer was killed by being struck by a broken side rod. The axle failed in the left main journal. In general, the failure was attributed to poor workmanship in machining the axle, as stated in Mr. Belnap's summary of the report which follows:

"The evidence presented in the investigation of the failure of the axle under engine No. 1056 conclusively shows that the workmanship in machining the axle was the prime cause of its failure. There was an area of metal on the surface of the journal which showed short and numerous cracks clearly attributable to the roughing cut taken in the lathe, the effects of which did not turn out in the finishing cut. These surface cracks afforded the opportunity required for such a concentration of stress as led to ultimate failure. The location of the place of rupture was an unusual one, being near the middle of the length of the journal, where the stresses in service would not ordinarily attain their maximum intensity. The presence of the surface cracks explains why rupture occurred at this unusual place.

"It further appears in the investigation conducted by the engineer-physicist that other fractures were in progress which eventually would have resulted in the failure of the axle. These additional fractures were located in the metal of the wheel seat, on the left-hand end of the axle. While the length of the hub of the driving wheel was 8 in. the length of bearing which it had on the axle ranged from only ½ in. to 1¾ in. The starting of incipient cracks in the wheel seat was doubtless influenced by this imperfect fit. An error was made in laying out the keyways, and two groups of holes were drilled and plugged in consequence. All of this evidence is derogatory to the class of workmanship needed in an axle. These facts concerning workmanship, however, would not be known after the engine had been assembled and put out on the road, but which nevertheless were the precursors of its ultimate failure.

"The quality of the steel of which the axle was made is not held responsible for the failure. Its examination, apart from the defects due to workmanship for which the metal itself was in no wise responsible, showed no connection between its failure and the quality of the steel. Its structural condition as regards initial strains showed a state of repose and comparative freedom from strains of magnitude in greater degree than the heat-treated axle which was examined, in quest of correlated data, in conjunction with it.

"Primarily, inspection should be made in the shop and assurance of good workmanship received before an axle is in the first place assembled in an engine; and in view of the grave consequences which sometimes follow and are likely at all times to follow the failure of an axle, any indication of a defective condition should be fully explored and the cause of such trouble ascertained before further movements of an engine are made, and those movements which are es-

sential to get the engine to a place of repair should be made with caution.

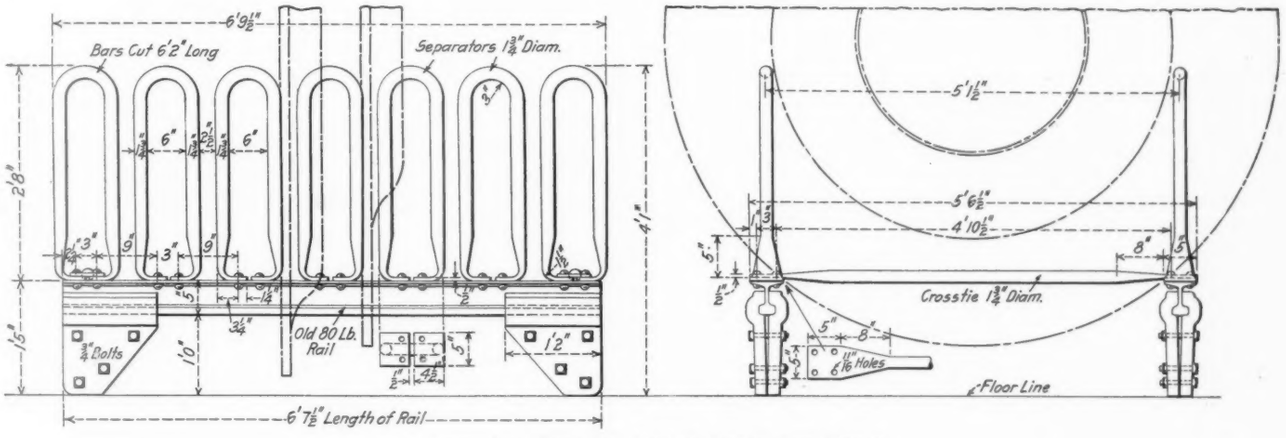
"There was warning given of impending failure when the engine was removed from the passenger train which it was hauling and replaced by another engine. Trouble was located in the oil-box cellar, but search was not continued sufficiently to ascertain why there was trouble with the cellar. The functions of the oil-box cellar are such that the real seat of trouble should be looked for in other parts of the mechanism, and the inspection not confined to the cellar alone. Had the inspection been more thorough and complete, it is probable that the real trouble would have been discovered and the accident averted, notwithstanding the defective workmanship which was shown to have existed."

RACK FOR STORING SMOKE BOX FRONT ENDS

BY JOHN H. NAGLE
Chief Draftsman, Buffalo, Rochester & Pittsburgh, Du Bois, Pa.

More or less trouble has been experienced in locomotive erecting shops when storing smoke box front ends after they are removed from the engines. After they are removed they are allowed to stand around the shop and if not properly supported they may fall and be broken, or may injure employees.

To avoid this the Buffalo, Rochester & Pittsburgh has designed a very neat and inexpensive rack for the storing of front ends when not in use. The racks shown by the illustrations are formed of a series of loops which stand in an upright position, spaced 2½ in. apart, which is far enough to allow a crane to handle the fronts. The uprights are formed of old 1¾-in. truss rods removed from gondola cars to which steel underframes have been applied. The carrying members are old 80-lb. rails and the supports are standard cast iron rail stops. The crossties are also made of old truss rods. The smaller rack is for front ends from 56½-in. in diameter to 66½-in. in diameter and the larger rack for front ends 70½-in. in diameter to 91¾-in. in diameter These racks are now in use at our various shops and have proved very satisfactory.



A Convenient Rack for Storing Smoke Box Fronts

MIXTURE FOR PREVENTING SCALING OF STATIONARY BOILERS.—A mixture for preventing scale in boilers, consisting of graphite and caustic soda in the proportion of 50 oz. to 30 lb., has been found effective, it is said, by the chief engineer of a private plant operating two 260-hp. B. & W. boilers. The boilers are treated alternately, the mixture being fed gradually to one boiler, and during that time it is not blown down. The other unit, however, is blown down every morning.—*Power.*

WHY HAVE AN APPRENTICE SCHOOL?

BY A. B. KERR
Apprentice Instructor, St. Louis & San Francisco, Springfield, Mo.

A blacksmith was vigorously protesting against the educational qualifications which barred his son from starting an apprenticeship. He claimed that one did not need an education in order to learn the trade—in fact, the real reason why he wanted his boy put on was because he did not make much progress in the public school. Now, this blacksmith was accounted a very good mechanic; he wasted scarcely any iron, his welding performance was somewhere close to 100 per cent, his heats were always neat and just about right. He was not a cut-and-try mechanic. He could not tell you just how he did secure results, but he got them just the same.

Shortly after this conversation the blacksmith was asked by an apprentice who was under instruction, why it was that too much draft in a fire was not a good thing for a welding heat. No answer was forthcoming. When after the next class period the apprentice explained the reason of scale or oxidization, he was submitted to much chaffing. Why, that was plumb theory; it was worse than that, it was c-h-e-m-i-s-t-r-y, a science, a study for long gray beards who puttered around and did little real work. This was a blacksmith shop where they were paid to get out the work.

This may appear to be exaggerated, but it is an example of what is occurring in most shops—not blacksmith shops alone, but all manner of shops. It is what has happened, what is happening and what will happen; it is the inevitable condition which surrounds progress. Progress may be called the pathway formed by practice following in the footsteps of theory; for no matter what the practice, a theory had first to be formed, a plan made before the action could take place.

To all mankind theory gives one common boon—the ability to think after a logical and conclusive manner. Since speech is an expressed thought, then, in order to speak knowingly, one must first be able to think coherently. Take the blacksmith, for an example; he could talk all around any fine point of his trade, yet he could not explain these points—he did not know the why.

Time was when a man was allowed to learn a trade or a business by personally practicing all its details; if asked to do a piece of work he had never done before, he had a satisfactory answer ready—he had never done it. Now, however, and it is becoming more so each day, men are called upon to do work that they have perhaps never heard of, and in a way they are expected to make good. Slotter, shaper and planer work, while performed on three separate and distinctly different machines, is yet of the same nature; few mechanics have experience on all three, but they are expected to be able to successfully do work on all of them. If one had first to per-

form all possible sums of addition before feeling proficient it would, indeed, be a hopeless task. We know that as quickly as the principle of addition is learned, it is all learned. The theory of anything is nothing more nor less than the principle of the thing, and once the principle is understood, the rest is but a case of applying what one already knows. Principle must be known, else each new job is as sailing over uncharted seas. Had the blacksmith known the theory of scale formation, he could have thought out the answer to the apprentice's question, even though it might have never before presented itself.

Furthermore, one theory or principle generally presents another, and this fact promotes more or less comprehensive reading and argument. It suggests and abets the exchange of ideas; it stimulates "shop talk," a desirable thing. The study and knowledge of a theory, then, promotes thinking; not dreaming, guessing or speculation, but thinking, the kind of thinking that requires effort and training.

Efficiency depends on sound common sense, upon basic principles followed out in a logical and a conclusive manner. Some schemes of efficiency have failed, others have been of pronounced success. There is generally a pretty fine line between a true failure and an honest success, and good sound practical judgment is always the line. Is it possible to make an efficient mechanic of a man who does not know the rudiments, the principles of his craft? If so, is he not like a nicely balanced boat fully laden and floating serenely, but if tipped even the slightest it will immediately sink out of sight? A man is not efficient if he is liable to capsize when any little irregularity presents itself; he is neither self-reliant nor resourceful, two quite important characteristics.

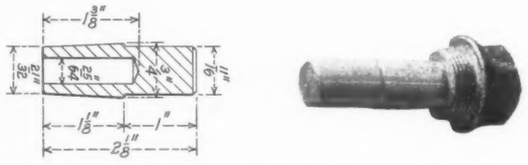
All men, and especially the younger ones, such as apprentices, junior clerks, etc., should be taught principle. They should not be put doing anything, or at least rarely, unless the theory or the true meaning of the work is first explained to them. First, because the employee is then in a better mood, cheerfully and intelligently, to perform the task. Second, because the employee is in training better to know the detailed demands of the business, to gain some idea of possible improvements or extensions of the business. Third, because the employer is so truly educating his men that they grow in self-reliance, resourcefulness and progressiveness. To any honest, aboveboard business there never has been any danger from education.

It is submitted that the desirable mechanic is the one who not only can do a particular piece of work, but knows how and can tell the other fellow.

DRIFT FOR TRUING UP SUPPLY VALVE STEM GUIDES

BY F. W. BENTLEY, JR.

The supply valve stem guides in the supply valve caps of Westinghouse air signal reducing valves are frequently found bent; that is they are not true with the rest of the cap and



The Drift and Its Application to the Valve Stem Guide in the Cap

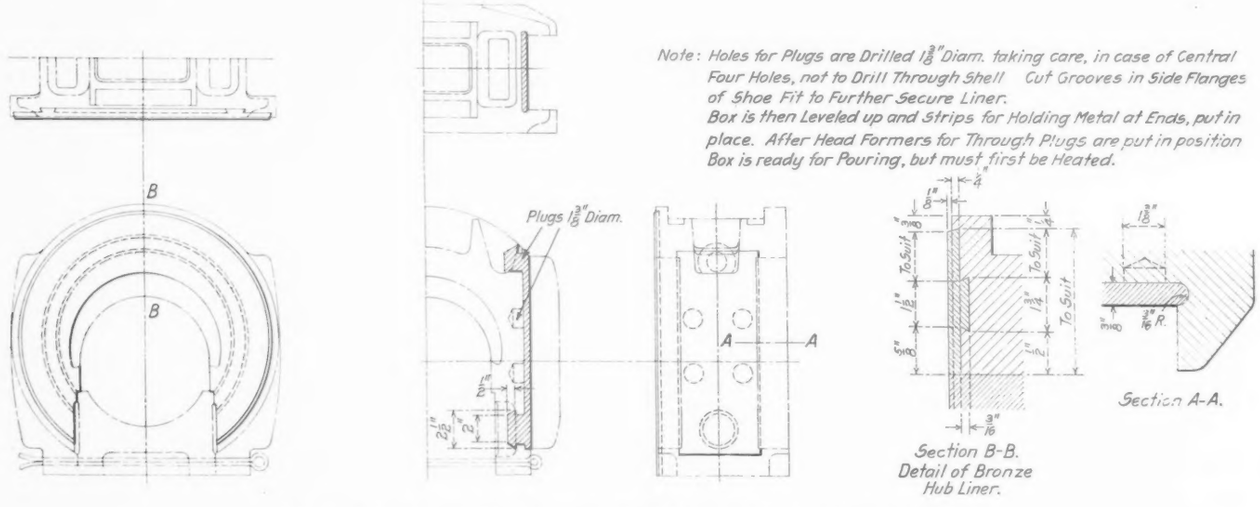
often to such an extent that the valve below will be forced to tip and overcharge the signal line. This condition results from a number of causes, such as working a dirty valve free in its bushing seat, trying to apply the valve cap without cutting out the cock, and a few other things that a careful man would not attempt. The sketch and photograph show details of a handy centering drift with which the guide can be quickly drawn into place. Both in the shop and roundhouse it will be found very convenient and worth the time taken to turn it up.

UNION PACIFIC METHOD OF FACING DRIVING BOX SHOE AND WEDGE FACES

The reclaiming of worn driving boxes by lining in the wedge and shoe faces with bronze has been quite extensively practiced on the Union Pacific, and greatly increases the length of service obtained from these boxes.

The method of applying the bronze is shown in detail in the drawing, the bronze being cast on the box and then machined to proper dimensions. Holes are drilled for 1⅜-in. plugs, those at the top and bottom passing through the shell, and grooves are cut at the corners of the flanges to further secure the liners. In pouring, special head formers are used in connection with the top and bottom holes, the heads securely holding the metal to the box.

The use of bronze for hub wearing faces has also resulted in a longer period between repairs, as the lateral motion does not increase as rapidly as with the usual babbitt facing.


Note: Holes for Plugs are Drilled 1 3/8" Diam. taking care, in case of Central Four Holes, not to Drill Through Shell Cut Grooves in Side Flanges of Shoe Fit to Further Secure Liner.
Box is then Leveled up and Strips for Holding Metal at Ends, put in place. After Head Formers for Through Plugs are put in position Box is ready for Pouring, but must first be Heated.
Plugs 1 3/8" Diam.
B
B
A
A
To Suit
Section A-A.
Section B-B.
Detail of Bronze Hub Liner.

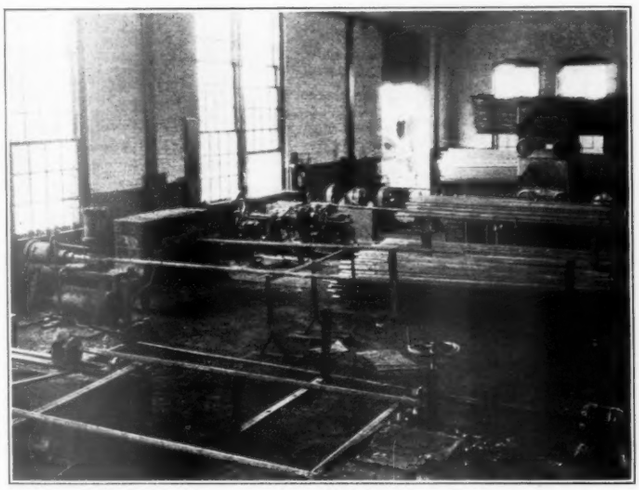
Details of Method of Reclaiming Worn Driving Boxes on the Union Pacific

OPERATION OF A GENERAL FLUE SHOP*

Description of Atlantic Coast Line Methods and Equipment. Safe Ends Are Electrically Welded

BY R. B. VAN WORMER
General Foreman, Atlantic Coast Line, Waycross, Ga.

WORK in the flue shop is practically a continuous operation, and the shop should be laid out with that end in view. The more continuous and rapid the work is performed the smaller the number of tubes it will be necessary to hold in stock. The tube cleaner should be located at the main entrance of the flue shop. The track facilities should be such that the second-hand tubes sent to the shop for safe-ending can be unloaded conveniently from the car to the cleaner. Similarly, suitable track facilities are necessary at the point where the tubes come out of the shop ready for service so that they may be conveniently and promptly shipped without delay. The accompanying diagram shows the general arrangement of the apparatus and track connections at the Waycross, Ga., shops of the Atlantic Coast Line. This flue shop is located in an ell or corner of the main shop building, and occupies a space 40 ft. wide by about 90 ft. long. A 10-ton overhead crane from another department beyond is used in this shop a small part of the time. All of the



Flue Shop at the Waycross, Ga., Shops of the Atlantic Coast Line

apparatus in the shop has individual motor drive, thus no belts or overhead shafting is required. The figures 1, 2, 3, 4 and 5 in the shop layout show the various stations of the workmen performing the consecutive operations. The letters designate the equipment, storage space and tracks.

The flue cleaner is located just outside the shop on the standard gage track running through the end of the flue shop and is designated as track *Y*. There is also another standard gage track marked *X*, passing through the building at the other end of the flue shop. The track *Z* is a run-around track common to all of the shops. The second-hand tubes shipped in from outlying points may be unloaded either directly from a car on track *Z* at *W*, into the cleaner, or, if they are received in an open car, from track *Y*, they being picked up with a crane and special slings provided for the purpose and loaded onto a special tube car and delivered to the cleaner. By the later method the tubes can be unloaded, placed in the cleaner and the cleaner started in not more than 15 minutes. The new tubes are received on track *X*, unloaded with an overhead crane and stored adjacent to the tracks as shown. About 500 new tubes per month are handled at this shop. All second-hand tubes are received with their firebox ends heading into the shop and at this general shop the arrangement is such that the tubes are removed from the boiler and replaced without being turned end for end.

*Abstract of a paper presented to the Southern & Southwestern Railway Club.

SHOP EQUIPMENT

Flue Cleaner.—The flue cleaner is the Ryerson overhead type, with suspended case-hardened chains. It will handle 500 2-in. tubes, 24 ft. long and at one time. This machine is driven by a 20-hp. motor and it raises and lowers the tubes into the pit by its own power. It may be loaded and started in less than 15 minutes, and unloaded onto the flue car in the same length of time.

Flue Cutter.—The flue cutter *B* is home-made and very simple in construction, consisting of a 4-ft. shaft secured at one end in a swivel bearing. The other end carries the disc cutter which is secured in a bearing carried on a screw, permitting the cutter to be fed down by hand. The shaft with the cutter is driven by a 2-hp. motor connected with the shaft by a silent chain for the necessary flexibility. This machine will cut off a cold tube in 7 to 10 seconds after it has been placed in the machine.

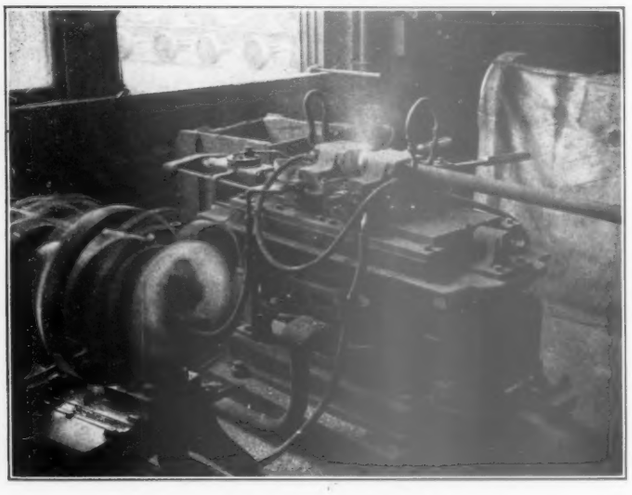
Safe End Machine.—The safe ends are made on a McGrath safe end cutting-off machine located at *A*. This machine is designed to automatically and correctly cut off safe ends to the various lengths for which it is set, and is so arranged that either stock or scrap tubing can be used. The machine also automatically scarfs the safe ends, but for electric welding this feature is unnecessary, since both the tube and safe end should be cut off square.

Electric Welder.—The safe ends are welded to the tubes by an electric welding machine made by the Thomson Welding Machine Company. This machine operates on a single phase, 60 cycle, alternating current at 440 volts. This voltage, however, is stepped down to 4 to 6 volts and with a current of 4,400 amperes requires about 22 kw. About 45 tubes per hour can be welded. The machine contains a break switch operated by foot treadle and another switch tapping the primary coil so that the current can be varied for different gages of tubes. On the top of the machine are two sets of quick-acting, water-cooled, bronze clamps, one for the tube and the other for the safe end. The safe end clamps are connected to a 5-ton double-acting oil jack operated by a convenient lever, which is used to force the safe end against the tube during the welding. The clamps are connected directly to the terminals of the secondary coil of the transformer. The entire surface of the tubes is gripped by the clamps so that the current will enter the tubes throughout their circumference. In operating this machine the tube and safe end are dropped into their respective dies and clamped; the switch is closed by the foot treadle; the tube and safe end begin to heat up instantly at their abutting ends in full view of the operator and when at a welding heat they are forced together by the jack, and at the same time the treadled switch is opened. The tube is then removed, having a thorough, sound but re-inforced or enlarged weld due to forcing the safe end against the tube. With this method of welding best results are obtained by using safe ends of the same thickness as the tubes. With the practice of welding the tubes

into the back tube sheet this is not a disadvantage, since the tubes are not worked to the extent, while in service, that they are when not welded. On the other hand, there is a distinct advantage in using safe ends and tubes of the same gage, as a large saving may be made in the purchase of new safe ends of the same gage as the tubes. By thus welding safe ends, sound, reliable welds are obtained, a welding furnace is eliminated, the outfit is compact, clean and comfortable for the workmen to handle and safe ends of any length can be welded. An interesting feature in connection with this machine is that it refuses to weld tubes that have become too thin, as the tube will burn before the standard safe end has reached a welding heat. This characteristic of the machine in no way interferes with successful welding where the difference in thickness is within reasonable and practicable limits.

Grinding.—For obtaining perfect and quick welds, it is necessary that the tube and safe end be clean and free from scale or rust where they are clamped in the copper electrode lining of the clamps. This is best accomplished by a slight grinding or polishing around the tube for about 2 in. in length. This is done on an emery wheel, for which purpose the double grinder *C* is provided; one wheel is used for the tube, and the other for the safe ends. As the safe ends are ground they are placed in the storage rack *D* convenient to the electric welder. The ground tubes are placed on suitable supporting rails at a convenient height for the machine. These rails extend across and serve the grinder, the welder and the roller.

Rolling Machine.—The rolling machine is located at *F*. It can be of several different designs, but it should be such that it will roll down both the inside and outside of the tube to its nominal size. An old Hartz flue welder can be used by boring out the spindle or main shaft carrying the rollers,



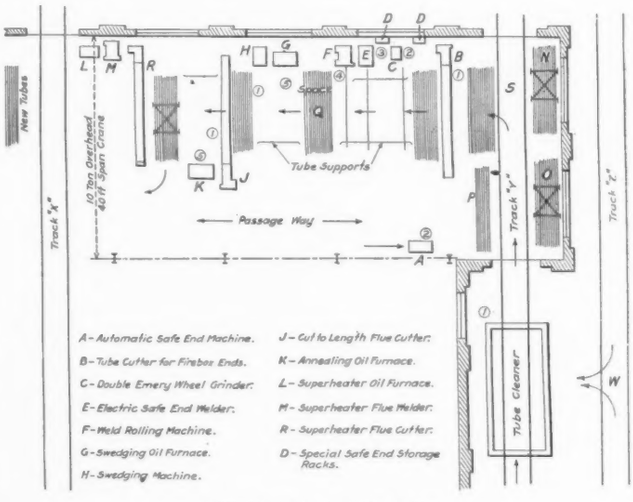
Machine for Welding Tube Safe Ends

together with a sufficiently long mandrel within this shaft to take a safe end 4 ft. in length.

Swedging Machine.—The swedging machine *H* consists simply of two air cylinders, one horizontal and one vertical. The vertical cylinder operates a clamp to hold the tube, and the horizontal cylinder shoves the die over the heated end. The two cylinders are operated by one foot-operated air supply valve conveniently located. Check valves with a small port drilled through each valve, are placed in the pipes leading to each of the cylinders. The valve in the die cylinder connection opens away from the cylinder while the valve in the clamp cylinder opens toward that cylinder. With this arrangement the clamp will be applied two or three seconds ahead of the die and it will be released two or three seconds later than the die. This machine will readily swedge 150 tubes per hour.

Flue Cutter for Cutting to Length.—The flue cutting machine *J* which cuts the tubes to exact length, is identical in design to the machine *B* except that a suitable stop for the tube has been added. This stop is adjustable, and can be set for any length desired. This machine is also equipped with a die or plate enclosing the swedged end of the tube in such a manner as to grind and smooth up the swedged end while the other end is being cut off. This arrangement eliminates any filing or preparation on the swedged end for setting the tube in the boiler. This machine is so located that the tube does not have to be turned end for end. Its capacity is 120 tubes per hour.

Annealing.—As fast as the tubes are cut to length, the smoke-box ends are placed in the annealing furnace *K* and


New Tubes
10 Ton Overhead 40 Ft. Span Crane
Space
Tube Supports
Passage Way
Track "X"
Track "Y"
Track "Z"
Tube Cleaner
A - Automatic Safe End Machine.
B - Tube Cutter for Firebox Ends.
C - Double Emery Wheel Grinder.
E - Electric Safe End Welder.
F - Weld Rolling Machine.
G - Swedging Oil Furnace.
H - Swedging Machine.
J - Cut to Length Flue Cutter.
K - Annealing Oil Furnace.
L - Superheater Oil Furnace.
M - Superheater Flue Welder.
R - Superheater Flue Cutter.
D - Special Safe End Storage Racks.

Layout of the Flue Shop

from these they are placed on the tube car. The rate of annealing is governed by the rate of cutting to length, as these two operations are carried on together.

SHOP ORGANIZATION

Inasmuch as the output of the entire flue shop is controlled by the output of the electric welding machine *E*, the operator of that machine, man No. 3, is held responsible for the output of the shop and is considered the head workman. The following is the route of the tubes through the shop and the duties of the five men connected with it:

After the tubes have been cleaned they are moved to the point *S* in the shop where they are gently unloaded by an overhead crane onto the floor between the track and flue cutter *B*. At this point man No. 1, who also operates the flue cleaner, cuts off the firebox ends of the tubes on flue cutter *B*, after which the tubes are rolled over onto the floor between the cutter *B* and the double grinder *C*. As each tube is cut off. it is inspected by man No. 1 for thinness and pitting. This inspection is closely followed and checked by both the boiler foreman and the chief inspector, and the condition of the tube determines the class of service in which it will be used. If any pitted tubes are found, those that are not too badly pitted and which may be reclaimed are set aside and the pits are filled in by welding in the space marked *P*. The scrapped tubes are set just outside the door near the track *Y*, where they are loaded once each week and sent to the scrap yard.

Man No. 2 grinds the tubes after they have been cut off and rolls them over on rail supports to the electric welding operator, No. 3. The rail supports between the grinder and welder should provide for not less than 30 ground tubes

at a time. As the tubes and safe ends can be ground at the rate of 90 and 120, respectively, per hour, which is twice as fast as they can be welded, the same grinding operator, No. 2, also is assigned to take care of the operation of the automatic safe end machine *A*.

The welding operator passes the welded tubes on to man No. 4 who rolls them down to size. They are then piled at *Q*, between the roller *F* and the swedging furnace *G*. Sufficient space should be provided at *Q* to permit storing 2 sets of tubes, so that new tubes which require no welding can be brought from their storage space *V*, heated, swedged, cut and annealed, without interfering with the continual operations performed on the second-hand tubes. This will be possible, as the heating, swedging, cutting to length and annealing is done at an average rate of 120 per hour. Second-hand tubes are sometimes taken from this pile and shipped to outlying points that swedge and out their own tubes. Such tubes usually are placed in special slings, so that they may readily be picked up, a set at a time, and loaded directly on a flat car at the tracks *Y* or *X* by the overhead crane without further handling or storing. Again there are cases, with some old engines, where it is necessary to wait until a new firebox or tube sheet has been applied before the proper length of tube is determined. In this case the tubes, after being welded and rolled, are loaded in a flue car at this space *Q*, and the car placed out of the way at the storage space *N* by the overhead crane without unloading. Then when the tube lengths are obtained, the car is returned to the space *Q*, and the tubes given their final operations without any interference or interruption in the other work.

Man No. 5 takes the tubes from the space *Q* and heats them in the oil furnace *G*, passing them over onto the supporting rails to man No. 1 who is now operating swedging machine *H*. The oil furnace *G* should be large enough to take not less than 8 tubes at a time, which will allow heating at the rate of 120 per hour. The tubes as swedged by man No. 1 are piled on the floor or a flue car to cool in the space between the swedging machine and flue cutter *J*. This space should accommodate not less than one complete set. When a whole set is loaded in a flue car, it is ready to be sent to the engine, or if the repairs to the boiler are not yet sufficiently advanced for the tubes, the flue car with the tubes can be temporarily stored out of the way at the end of the flue shop at space *O*, where they may be tiered three and four cars high by the overhead crane.

Superheater Flues.—The superheater flues are handled at the extreme end of the shop, all cutting off being done on the cutter *R*. They are heated in the oil furnace *L*, and welded on the Hartz welder *M*. This is of the usual type, equipped complete with mandrels and formers for welding flues up to 5⅜ in. in diameter. It is driven by a 5-hp. motor.

DISTRIBUTION OF WORK

The distribution of the work is such that when the shop is working to maximum capacity no one man is overworked and man No. 5 will have about one hour per day, which he devotes to cleaning up the shop, distributing safe ends, loading scrap tubes, oiling machines, etc. The labor for the flue shop, based upon the maximum output of 450 second-hand flues in 10 hours, is as follows:

Cleaning	½ hour	Man No. 1
Inspecting and cutting firebox ends	7½ hours	Man No. 1
Grinding body flues	5 hours	Man No. 2
Grinding safe ends	3¾ hours	Man No. 2
Welding	10 hours	Man No. 3
Rolling	10 hours	Man No. 4
Heating for swedging	3¾ hours	Man No. 5
Swedging	3¾ hours	Man No. 1
Cutting to length	3¾ hours	Man No. 1
Annealing and loading	3¾ hours	Man No. 5
Transportation to and from the flue shop, estimated	15 cents	

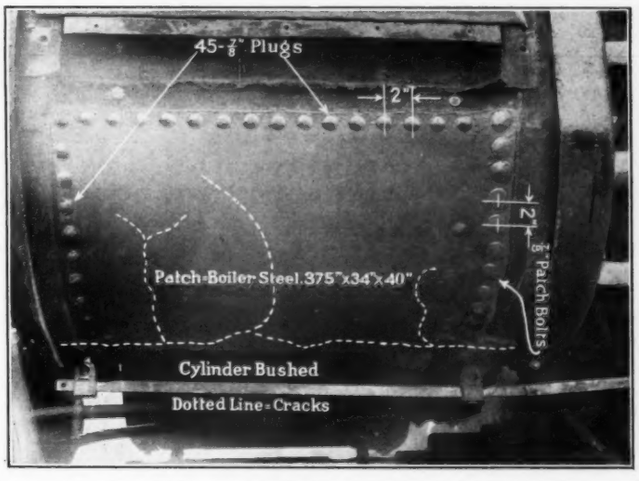
It is the practice at this shop to weld the tubes into the back tube sheet. The tubes are applied in the customary manner before welding. The cost of welding is about 21 per cent of the total cost of the work done on the tube from service back to service. This is comparatively high, but it is fully justified by the saving effected in the cost of running repairs on tubes, as well as in the reduction of engine failures from tubes leaking in service.

BOILER STEEL CYLINDER PATCH

BY W. P. HOBSON
Master Mechanic, Chesapeake & Ohio Railway, Covington, Ky.

During the past several months three of the superheater Mikado type locomotives handled at Huntington have developed cracks in the cylinders. It was either necessary to apply a permanent patch or renew the cylinders. As applying new cylinders is quite a costly job, we undertook the application of boiler steel patches. The service of these patches so far has been entirely successful and the indications are that the job is a permanent one.

The photograph shows clearly how the patching was done



Method of Applying Boiler Steel Patch to Cylinder

on one of the locomotives. The cost of labor and material in applying the patches to the three locomotives averaged $25.65. When compared with the cost of applying new cylinders, it will be seen that this method of repairs was well worth trying.

PNEUMATIC CLAMPING AND HOLDING-ON DEVICES

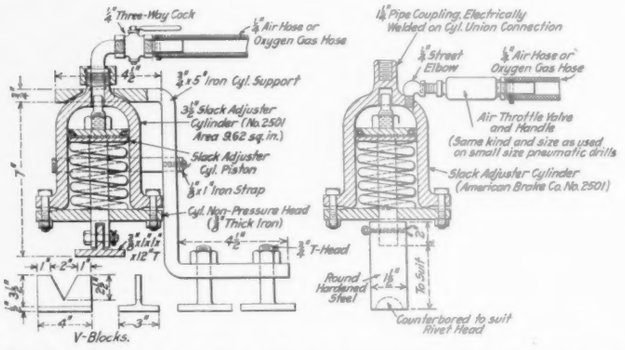
BY FRANK J. BORER
Foreman, Air Brake Dept., Central Railroad of New Jersey, Elizabethport, N. J.

The two sketches show simple devices which we find very useful. They can be made up at a small expense at almost any shop.

The pneumatic clamping device for use on a drilling machine saves a good deal of labor and prevents the breaking of drills due to poor clamping or holding of the part being drilled. This was originally constructed for holding air hose couplings while drilling out broken stop pins, but it was found to be equally useful when drilling bolts, pins, plates and various kinds of passenger car trimmings. We use it in connection with the regular shop air pressure, which is 100 lb., giving a pressure of about 960 lb. at the piston. When not needed, or if in the way of large pieces which are to be drilled, the device can easily be detached from the drill table in a few seconds. The piece of ⅜-in. tee iron at the lower end of the cylinder piston rod can be made of any length or shape to suit the class of work to be drilled. When drilling round parts such as rods, etc., a pair of small "V"

blocks such as shown in the sketch will be a convenience.

We are using the holder-on device for riveting in close quarters, such as on steel center sills, draw gear parts and for safety appliances wherever convenient. When riveting car side steps, etc., any suitable length of 1¼ in. pipe may


¼" Three-Way Cock
⅜" Air Hose or Oxygen Gas Hose
1¼" Pipe Coupling, Electrically Welded on Cyl. Union Connection
¾" Street Elbow
⅜" Air Hose or Oxygen Gas Hose
Air Throttle Valve and Handle (Same kind and size as used on small size pneumatic drills)
Slack Adjuster Cylinder (American Brake Co. No. 2501)
¾"x5" Iron Cyl. Support
3½" Slack Adjuster Cylinder (No. 2501 Area 9.62 sq. in.)
Slack Adjuster Cyl. Piston
⅜"x1" Iron Strap
Cyl. Neg.-Pressure Head (⅜" Thick Iron)
¾" T-Head
Round Hardened Steel
To Suit
Counterbored to suit Rivet Head
V-Blocks.

Pneumatic Clamping Device for Drill Press and Holder-On for Riveting Work

be screwed into the 1¼ in. pipe coupling, thus giving the device a larger range of use.

Where more power is required, either device can be built up from a 4½ in. size slack adjuster cylinder (Form J) with excellent results.

PNEUMATIC RIVETING MACHINE

BY E. A. MURRAY
Master Mechanic, Chesapeake & Ohio, Clifton Forge, Va.

A pneumatic machine for riveting coupler yokes, which can be built without recourse to patterns, is shown in the illustration. An ordinary 16-in. air brake cylinder is used to furnish the power, which is transferred to the riveter through a wrought iron fulcrum arm working in an arbor, built of bar iron.

This machine was designed and built at the Clifton Forge shops. After it had been put into use, it was found to be handy in straightening out couplers having the shanks or lugs bent. The bent parts are heated and the coupler placed in the machine and power applied.

The rivet holes in the couplers are usually 1 5/16 in. in diameter. The rivets are forged to this size for a distance of 1½ in. under the head so that they are applied with a driving fit on one end. The opposite end is heated and when the pressure is applied the rivet is upset, filling the hole. This method of riveting the coupler yoke has proved very successful.

TURNING A BOILER MAKER APPRENTICE INTO A GOOD MECHANIC

BY DANIEL CLEARY
San Antonio & Aransas Pass, San Antonio, Texas

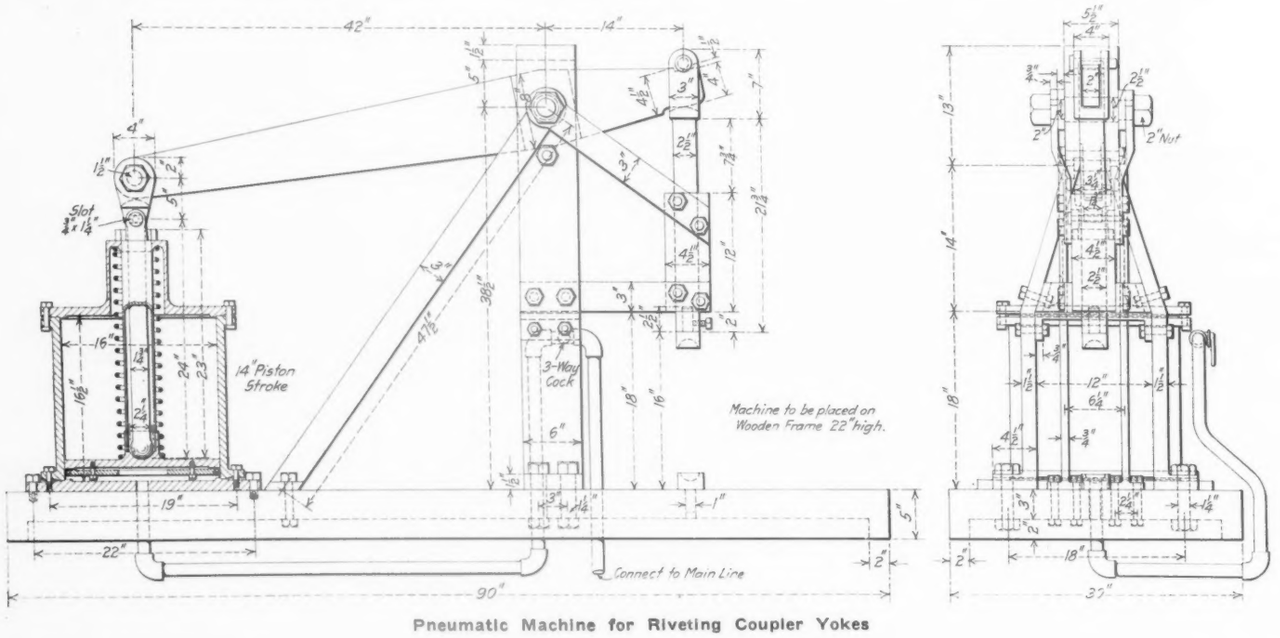
A boilermaker apprentice should be started at the rivet forge. He should learn how to heat rivets if it takes 60 days to do the job. Some day he will drive mud ring or crown bar rivets and if he knows the proper heat for riveting, he will not try to make a joint with a rivet that is either too hot or too cold.

At the first opportunity the new apprentice should be taken to a grindstone or emery wheel and be shown how a twist or common flat drill should be ground. Seventy-five per cent of the boilermakers have to grind their own drills in small shops and roundhouses. He should be shown that flat chisels should have the corners rounded off, so that the sheet next to the one that is being chipped will not be gashed 1-16 in. deep. The reason for clearance on cape and round nose chisels should also be explained.

When it comes to putting sheets together, the best job to start him on is petticoat pipes. Some day he will have to build a boiler shell and he will then know enough not to get the seams flat. He cannot depend on steam pressure to make a flat seam in a boiler shell assume a true circular curve.

When it comes to laying out work, the apprentice should be told to get a good book on that subject, some drawing tools and to study at home. While he should be put with a good layout man he should also be given to understand that on this particular job he must do more than listen to instruction.

If placed with a first-class man on patch work, it will not be long before the apprentice will find that all the holes cannot be put in flanged patches until the patches are in place, iron to iron. He should be put with a man who will



Pneumatic Machine for Riveting Coupler Yokes

allow him to handle the tools himself. In this way he will gain confidence and learn kinks that it would take him a long time to pick up otherwise.

Before starting a man on the job of taking out and renewing broken staybolts explain to him that the threads on opposite ends of new staybolts should check inch for inch at the top. Otherwise when he puts in a staybolt that is half a thread out, the bolt as it enters the opposite plate will force the thread off its base and in a few trips the staybolt will be leaking and have to be hammered up. It is then only a straight piece of round iron with about a 3-16-in. metal head and will leak continually. This will give the boiler a very untidy appearance. For some reason or other these threadless bolts are nearly always found in most inaccessible places, such as behind eccentrics or feed pipes.

Show a young man that by using his brains he can order his machine and blacksmith work ahead and double the amount of work he can do. The mechanic who sends his helper for bolts or taps and when he brings them, sends him back again for wrenches to fit them, does not get along very fast.

You may start an apprentice putting on a flanged patch some day and he will drill all the holes before he gets it fitted, iron to iron. Some of the holes will be ¼ in. out. Do not let him fill these with rivets, but make him throw the patch away and do the job over again. Next time he will not even try to fit the patch that way.

A foreman boilermaker having young men under him learning the trade should be just as careful to see that he is turning out good mechancis as that he is turning out good boiler work. I would not encourage a son of mine to learn the boiler trade. It is dangerous, it will make you deaf and will ruin your disposition. However, there always seem to be young men willing to learn the trade. Unless you make good mechanics out of them, you are turning them into tramps, for they will be continually going from place to place looking for work because they did not learn the trade right in the first place.

EFFECT OF SULPHUR IN RIVET STEEL*

BY J. S. UNGER
Manager, Central Research Bureau, Carnegie Steel Co.

Sulphur in steel, whether justly or unjustly, is held responsible for the bad working of steel. As a result the specifications covering the allowable amount of this element have been gradually lowered, until in certain cases below .030 per cent is the limit demanded. It is very difficult to reach this limit, and when reached there are grave doubts in the minds of many whether the quality of the steel has not suffered by the excessive purification required.

It is almost the universal practice, when steel shows a tendency to work badly or becomes red short, to make an analysis of the steel. If this analysis indicates that the steel has the proper or permissible amounts of the usual elements, but happens to be a few thousandths of a per cent higher than the specified amount of sulphur, the sulphur is held responsible for the trouble. Such decisions are made without considering any other influences, such as the heating for rolling or the subsequent heatings necessary to work the material up into a finished product. Very few users of steel appear to have either the time or inclination to make a few trials at slightly higher or lower temperatures in manufacturing their particular product, to determine if they are using the temperature at which the iron will work the best. The argument usually presented by them is that the greater part of their steel works satisfactorily with their shop methods, and they should always receive steel of the same quality. There is a certain amount of justice in the argument, but sometimes it is based on an opinion which does not include all the factors in the case. At least four factors influence the results: No two heats of steel are exactly alike; no two users of steel use exactly the same methods in fabricating the finished product; no two operators in the same shop work exactly alike, and the same material may work well at one time and unsatisfactorily at another, in the same shop.

The purpose of the experiments described was to study the effect on the working and physical properties of rivet steel by gradually increasing the amount of sulphur in the steel, until it had been raised to a point far above that usually found in such steel.

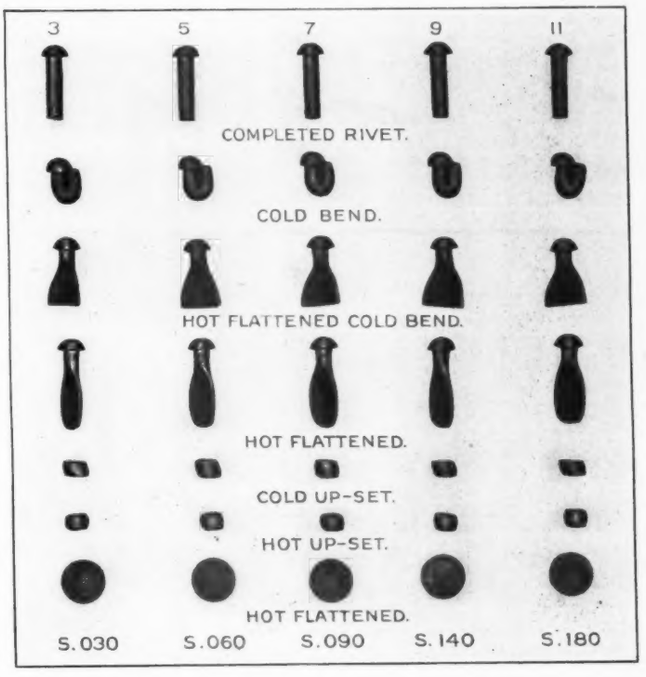


Fig. 1—Results of Hot and Cold Bending and Flattening Tests

The steel used was regular basic open hearth of carbon .09 per cent; manganese, .43 per cent; phosphorus, .012 per cent; sulphur, .031 per cent. The sulphur content of certain ingots from this heat was increased progressively by adding weighed quantities of sulphur, the additions being regulated to secure as near as possible a uniform increase of sulphur from one ingot to the next higher. The heating and rolling was done in the regular way and all ingots were treated exactly alike. The finished ¾-in. diameter rounds were alike in every particular as regards composition, heating and

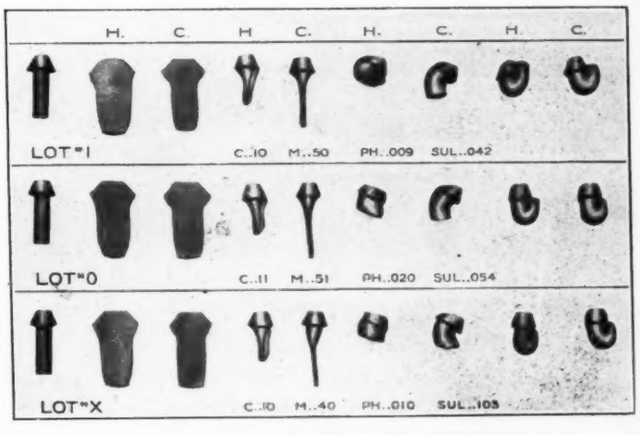


Fig. 2—Hot and Cold Forging Tests

*From a paper read before the American Boiler Manufacturers' Association.

rolling, excepting that they carried different amounts of sulphur. The rolled bars showed the following amounts of sulphur: .03 per cent, .06 per cent, .09 per cent, .14 per cent and .18 per cent.

The hot working properties and some of the cold working properties are shown in Fig. 1. In Fig. 2 are shown some tests made on three separate heats of steel with different sulphur contents. A study of the appearance of the tests shows

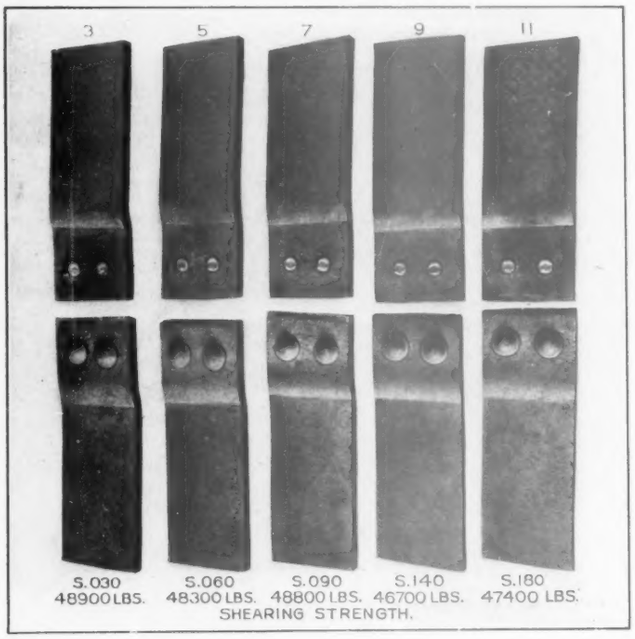


Fig. 3—Shearing Test

very little difference between the low sulphur rivets and those containing six times as much sulphur.

To determine what might be expected of the rivets when in actual service, a number of bars were riveted together.

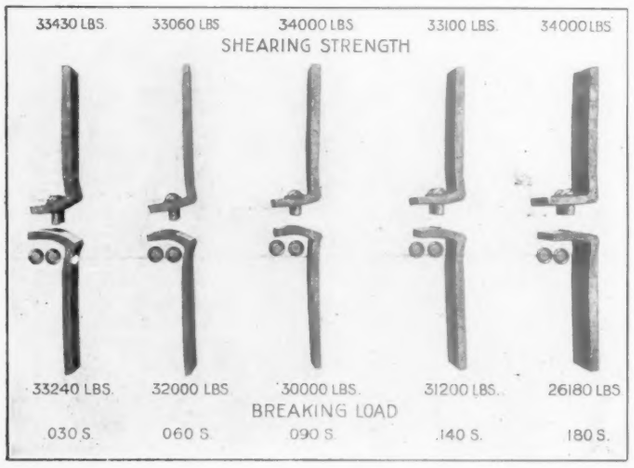


Fig. 4—Tension Test

These samples were then tested to destruction with the results shown in Figs. 3 and 4 and with the breaking loads given in Table I.

TABLE I.—DESTRUCTION TESTS OF RIVETED JOINTS AND ANGLES

Sulphur content	Riveted joints	Riveted angles
	lb.	lb.
.030	48,900	33,240
.060	48,300	32,000
.090	48,800	30,000
.140	46,700	31,200
.180	47,400	26,180

Results of tensile and bending tests on the rolled bars of .09 per cent carbon steel are shown in Table II.

TABLE II.—TENSILE TESTS OF ¾ IN. DIAMETER ROUNDS AS ROLLED

Sulphur content	Elastic limit,	Ultimate strength,	Elongation in 8 in.,	Reduction of area,
.030	31,360	50,460	30.8	64.2
.060	32,740	50,900	30.2	65.3
.090	30,890	51,400	31.2	62.5
.140	31,600	50,700	32.5	64.2
.180	31,530	50,960	30.7	62.3

In Fig. 5 are shown the results of tests made on extra long rivets under ordinary conditions to determine if one

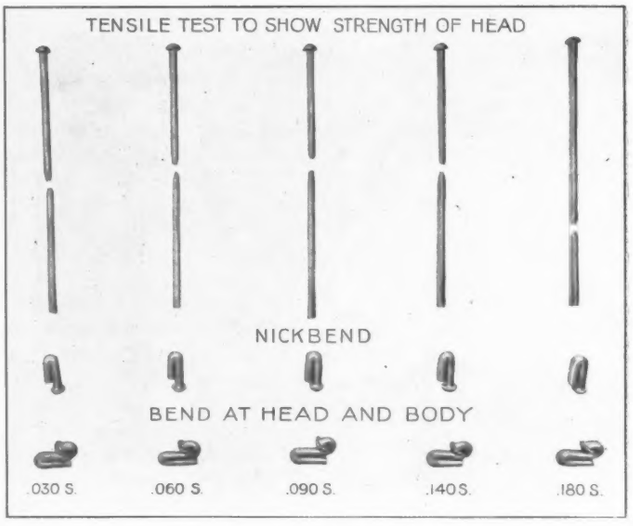


Fig. 5—Tests of Rivets in Ordinary Cold Condition

rivet head would stand as well as another. The nick bends and bending the head of the rivet were made to see if any differences would be found in these cold bends due to the varying sulphur content. Fig. 6 shows a similar set of tests, but in this case the rivets were heated to a driving heat (1,200 deg. C.), then taken out of the fire and quenched in

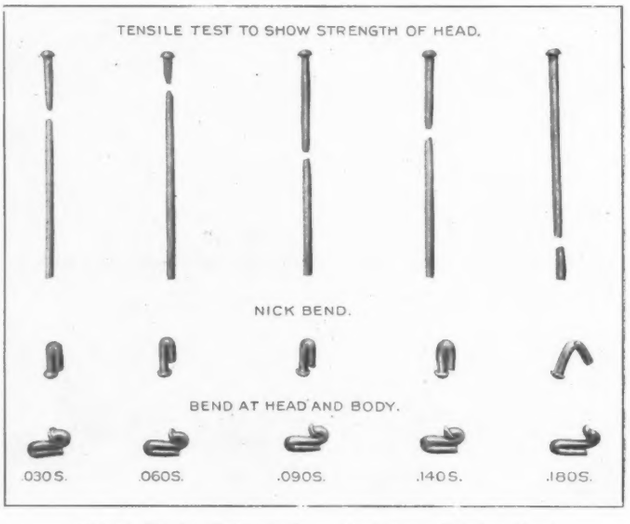


Fig. 6—Tests of Rivets Quenched from Driving Heat

cold water to show the effect of drastic cooling from a high temperature. A third set of tests, similar to those shown in Figs. 5 and 6, were made on rivets which were heated to a blue heat (350 deg.), and then quenched in cold water. The results of these tests were in appearance similar to those shown in Fig. 5.

The object in all these tests was to show whether the different treatments affected the rivets differently and whether

the rivets with higher sulphur content were affected to a greater degree than those with lower sulphur. Tables III, IV and V give the results of the tensile tests.

TABLE III.—TENSILE TESTS OF ¾ IN. RIVETS IN THE ORDINARY CONDITION

Sulphur content	Elastic limit,	Ultimate strength,	Elongation in 8 in.,	Reduction of area,
.030	34,010	51,740	34.2	70.2
.060	32,820	51,050	34.6	70.4
.090	37,480	51,620	36.0	67.3
.140	34,320	50,320	33.7	67.1
.180	33,340	51,050	37.4	65.8

In addition to these tests, a double shearing test was made on the ¾-in. rounds of each sulphur content in the ordinary condition. The shearing strength of each is given in Table VI.

TABLE IV.—TENSILE TESTS OF ¾ IN. RIVETS QUENCHED IN WATER FROM 1,200 DEG. C.

Sulphur content	Elastic limit,	Ultimate strength,	Elongation in 8 in.,	Reduction of area,
.030	44,100	69,700	8.1	62.5
.060	44,450	71,160	9.8	62.7
.090	54,690	76,600	7.6	53.7
.140	49,380	70,520	11.1	58.3
.180	43,730	67,850	10.6	54.8

The results of tests and the photographs speak for themselves. These results can be duplicated by anyone who has the necessary facilities. It is believed that the tests indicate the fitness, for most purposes, of a steel rivet containing slightly less than .10 per cent sulphur. So far as the author has been able to determine, there does not appear, by working tests or mechanical tests made on the finished rivet, to be any way of distinguishing between the quality of a rivet of .030 per cent sulphur and one of .090 per cent sulphur, if both have been subjected to the same conditions of treatment.

TABLE V.—TENSILE TESTS OF ¾ IN. RIVETS QUENCHED IN WATER FROM 350 DEG. C.

Sulphur content	Elastic limit, lb. per sq. in.	Ultimate strength, lb. per sq. in.	Elongation in 8 in., per cent	Reduction of area, per cent
.030	32,700	50,630	23.0	61.5
.060	31,060	50,400	25.0	59.4
.090	33,430	50,140	32.8	59.2
.140	32,060	49,500	32.0	60.8
.180	32,200	50,510	34.0	60.4

For many years before basic open hearth steel became common, millions of rivets of wrought iron or Bessemer steel were made and used. Bessemer steel is considerably higher in phosphorus, and in most cases higher in sulphur, than basic open hearth, and the greater number of such Bessemer steel rivets are still in service. This is the best possible evidence that steel may contain a much higher sulphur content than is specified today in open hearth steel, without injuring the quality of the rivet.

TABLE VI.—SHEARING TESTS OF ¾ IN. ROUNDS

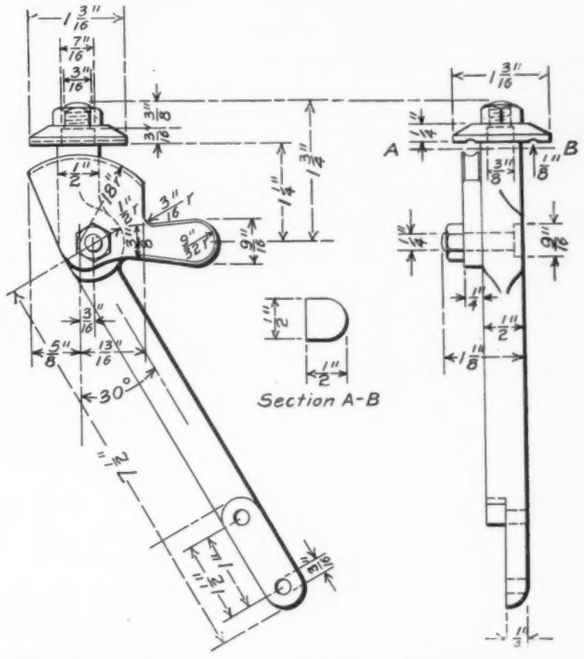
Sulphur content	Shearing strength in lb., double shear
.030	33,430
.060	33,060
.090	34,000
.140	33,100
.180	34,000

A USE FOR OLD PHONOGRAPH RECORDS.—The wax of old phonograph records may be used with satisfaction on tracing cloth when erasures are necessary. The wax rubbed over the erased portion gives the paper a gloss and finish similar to the original surface and prevents the ink spreading in the lines.—*Machinery.*

ELECTRODE HOLDER FOR ELECTRIC WELDING AND CUTTING

BY C. W. SCHANE

The attached sketch shows a carbon or wire holder for use in cutting or welding locomotive fireboxes and general boiler work, where the electric welder is used. The handle of the holder is placed at an angle of 30 deg. from the center line of the holder, so that the wire will be at right angles to the workman. The wire is held in position by a segmental cam lever, which acts against the underside of a disk head. The cam and disk are grooved and when the wire is fastened in this groove it will not loosen as the tendency to press against the metal holds the cam closed.



Simple Carbon or Wire Holder for Use in Electric Welding

One of these holders has been in continuous service 24 hours a day for four months and is still giving excellent results. In all electrical appliances a good, firm contact will give the best results, and this holder has fulfilled this requirement. It does not heat or burn as others which we have tried.

INSPECTION OF LOCOMOTIVE SPARK ARRESTERS AND ASH PANS*

There are being made on some of the roads comparative tests of the different shapes of mesh, also of the different designs of appliances, but on account of the difference of opinion at this date, we are unable to arrive definitely at what design of front end spark arresting arrangement would be best suited to the locomotives, and at the same time, reduce the emission of live or glowing sparks to the minimum. On some of the roads different appliances are being tried out and it will, of course, take some time to arrive at the merits, but the committee thinks there is no doubt but what there will soon be developed a locomotive front end spark arrester that will greatly reduce, if not altogether overcome, the emission of live sparks from locomotive stacks.

In obtaining from a number of railroads the practice of inspecting the front end arrangements, we find a great

*From a committee report presented at the third annual meeting of the Railway Fire Protection Association, held in New York, October 3-5, 1916.

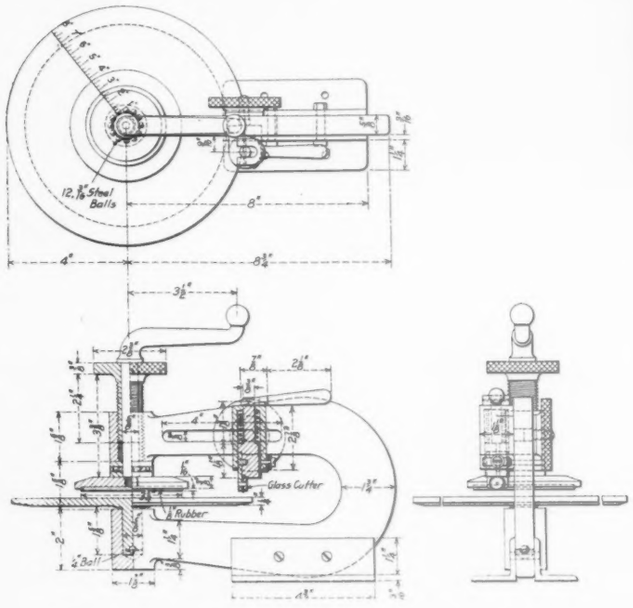
variance in the practice. On some railroads the inspection is made after each trip, while on other roads inspections are made once a week, and on others but twice a month. It is the opinion of the committee that the practice of thoroughly inspecting the front end arrangements at the terminals after each trip of the locomotive should be extended to all railroads, and it is also the opinion of the committee that if this practice is carried out, the hazard of sparks emitted from the stacks will be greatly reduced. When speaking of inspection, we believe that men assigned to such duties should be thoroughly familiar with the front end arrangements, and in every instance the inspection should be made in a very thorough manner and a record kept of the condition.

The committee has obtained from several railroads blue prints describing ash pan arrangements. We find that the pans adopted by the different roads are meeting the requirements, from the information we have received the most popular designs being the double sloping pan and the sliding hopper bottom pan. We feel sure that these two designs of ash pan, if properly cared for at the terminal, will be the means of greatly reducing the hazard of fire from this source. We believe that the plan of a thorough inspection should be carried out, the inspections to be made at the terminals at the end of each trip, and a record kept of the condition.

GAGE GLASS CUTTER

BY E. A. MURRAY
Master Mechanic, Chesapeake & Ohio, Clifton Forge, Va.

Glasses used in steam and air gages at the Clifton Forge shops of the Chesapeake & Ohio are cut by a machine, shown in the illustration, which was designed and built at this shop. It consists of a U-shaped frame similar to the frame of a punch or shear. On the bottom member of this frame is a table plate, which is free to revolve on ball bearings. On the top member is a rubber-lined clamp. Placing a piece of glass



A Simple Device for Cutting Steam or Air Gage Glasses

on the table plate, an adjustment screw forces the rubber-lined clamp down solidly against the glass. The crank arm, which is above the adjustment screw, is revolved and with it the table plate, glass and clamp.

In the top arm of the frame is a slot running lengthwise. The cutter frame works in this slot and has a clamp attached so that the frame can be moved back and forth to secure any diameter glass desired.

PATCH APPLIED BY ELECTRIC WELDING

BY W. J. GILLESPIE
Boiler Inspector, Pittsburgh & Lake Erie, McKees Rocks, Pa.

The patch shown in the illustration was made necessary on account of a vertical fracture that developed below the center arch tube, extending down to the second line of staybolts as shown by the white line. A section of the sheet embracing the arch tube opening was removed and a patch

Patch Applied to Back Tube Sheet by Electric Welding

marked off from it. The arch tube and staybolt holes were drilled, the patch set up and the staybolts applied. The seam was then filled in by electric welding and the arch tube applied. This work was done in January, 1915, and the locomotive has since been in continuous service until July, 1916, when it was shopped for renewal of the firebox.

BOILER TUBES AND SCALE.—Eminent authorities agree that a layer of scale one-tenth of an inch thick, and a steel boiler plate ten inches thick, offer exactly the same resistance to the passage of heat.—*Railway and Locomotive Engineering.*

LIGHT MACHINE OIL.—To make a first-class oil for light machinery, take a bottle about half full of pure olive oil, place in it some thin strips of sheet lead, and expose it to the sun's rays for a month, then pour off the clear oil.—*Pemberthy Engineer and Fireman.*

BABBITT BEARINGS.—In motors for very heavy duty the pendulum seems to be swinging back toward babbitt bearings. A good babbitt bearing is more expensive than a good bronze one by 1 per cent of the motor cost. A bearing babbitted with a high-grade tin babbitt calls for an increase of 0.6 per cent. over a cheap babbitt, but is a good investment.—*Power.*

New Devices

BALANCED DRAFT FOR STATIONARY BOILERS

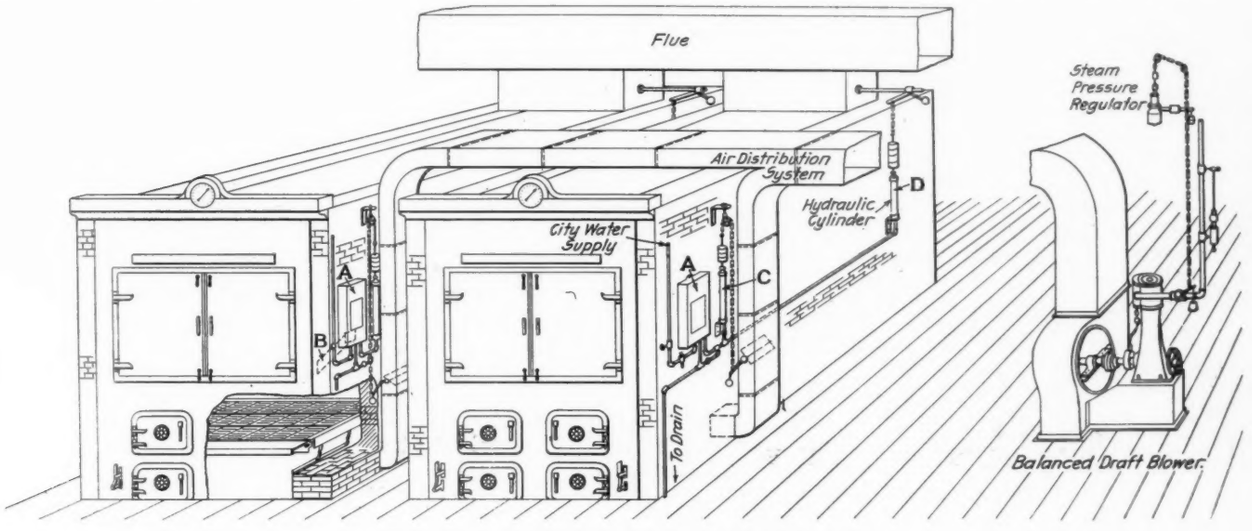
The conditions on a railroad are such that the stationary boiler plants are required to use coal that is not found desirable for locomotive use. This means that they are often furnished with poor grades of fuel and that unless proper supervision is given, or proper facilities provided by which this fuel may be used to the best advantage, economical results will not be obtained. Those roads that have studied the fuel question thoroughly have not neglected the stationary plants, and several have applied what is known as the "balanced draft" to the boiler plants, with an appreciable saving in fuel cost and an increase in the boiler capacity.

The purpose of the balanced draft is to automatically maintain at a constant, the draft pressure or vacuum in the boiler furnace which will give the proper combustion efficiency. In other words, it so regulates the air supply that the correct amount will be admitted to the boiler furnace to properly consume the coal, no matter what the thickness of the fuel bed may be. With an insufficient air supply some of the gases from the coal will pass out through the chimney unconsumed, and with an oversupply of air the efficiency of the boiler will be decreased, in that the surplus air will absorb and carry away the heat that should be absorbed by the boiler.

The apparatus by which this constant draft is obtained is shown in the accompanying illustration. A forced draft is obtained from the blower on the right, the speed of which is regulated through the speed pressure regulator by the steam pressure in the boiler. This blower provides a constant volume of air to the ash pit at variable pressures for a given speed of the blower. The draft above the fuel bed is maintained constant by the regulator *A*, which consists of a carefully balanced diaphragm supported by knife edges on suitable rests. As shown in the boiler setting at the left, the diaphragm box is in communication with the furnace through the passage *B*. As the pressure or vacuum in the furnace varies, the diaphragm moves and operates a water valve which controls the damper regulators *C* and *D* controlling the dampers in the blower pipe and the up-take respectively. The system is so arranged that the blower pipe damper moves to its extreme position before the up-take damper operates. The diaphragm is set to maintain a vacuum above the fuel bed of about .003 in. of water, which is practically equal to the pressure of the atmosphere.

The advantages of this system of draft control are many. As stated above, its purpose is to provide automatically the proper amount of air for complete combustion of the fuel, no more and no less. It maintains a more uniform temperature in the boiler. With the small amount of draft above the fuel bed practically no cold air is drawn in through the leaks in the boiler setting nor through the door as it is opened for firing. For these reasons the boiler is not subjected to sudden changes in temperature, and as a result the life of the boiler is increased and the cost of maintenance decreased. With the light draft required with this equipment the hot gases pass through the boiler at a low velocity, giving the heating surface sufficient time to absorb a maximum amount of heat. With the steam pressure regulator the boiler pressure is maintained more nearly constant, provided sufficient fuel is placed on the grate. This system permits of a cheaper grade of fuel being used, and as the regulation is automatic expert firemen are not required to fire the boiler. It eliminates the varying draft obtained where only chimney draft is used, and limits the function of the chimney to that of conveying the products of combustion away from the boiler.

The balanced draft system, which is controlled by The Engineer Company, 17 Battery Place, New York City, has been adopted quite extensively in industrial plants, and is in use on several railroads in the middle West, including the Chicago, Burlington & Quincy, the Illinois Central, the Atchison,



Arrangement of Balanced Draft for Stationary Boilers

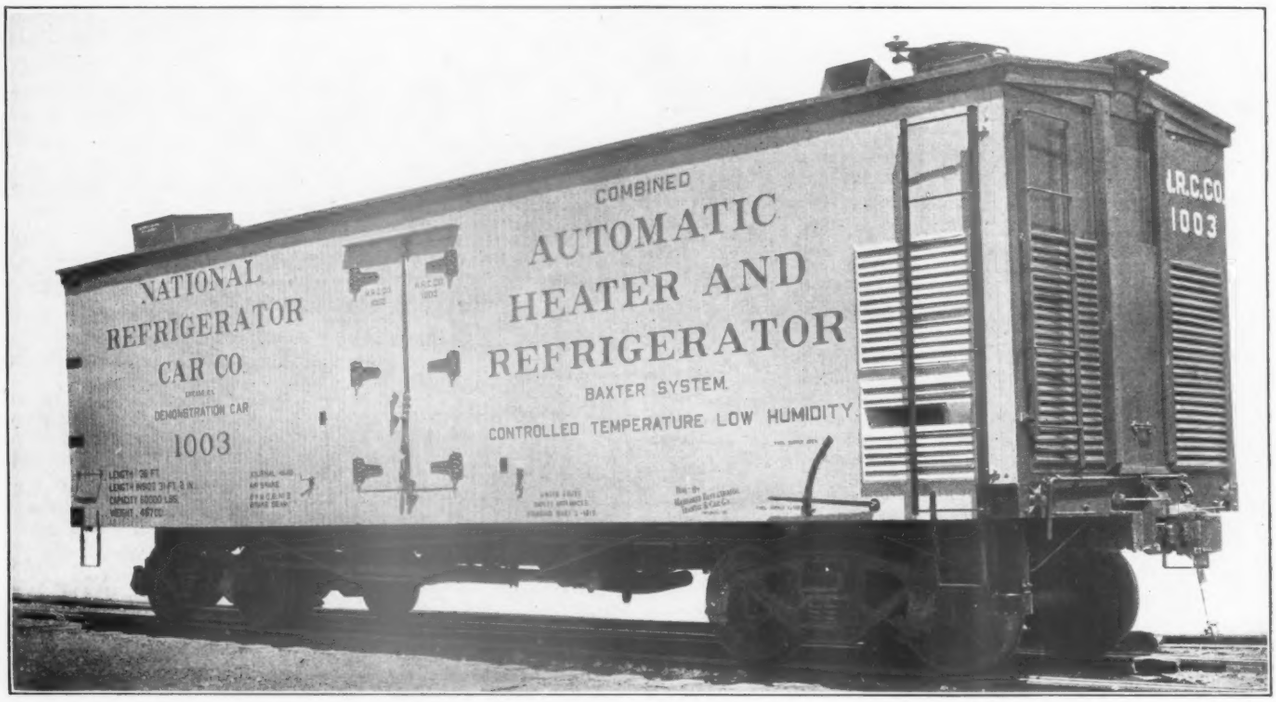
Topeka & Santa Fé, Chicago & North Western, Chicago Great Western, Chicago & Eastern Illinois, Wabash, Duluth, Missabe & Northern and the Chicago, Indianapolis and Louisville. Tests made by one industrial plant have shown an increase of 13.25 per cent in the equivalent evaporation over and above that which was obtained when natural draft was used, and with a coal that cost 30 per cent less per ton. In tests made by a railroad in the West an increase in equivalent evaporation of 12.52 per cent has been obtained. Other tests have shown similar and even greater increases in boiler efficiency. Since cheaper grades of fuel can be used and the boiler maintenance is less, the ultimate savings are greater than those shown by the increased evaporation.

AUTOMATIC REFRIGERATOR AND HEATER CAR

The refrigerator car in use on the railways today has been improved from time to time with a view of decreasing the amount of ice consumed and to provide a more perfect circulation of the cold air through the car. While these improvements have been more or less successful, the perishable freight shippers have never been given the protection that they have been able to secure in the modern cold storage warehouse. In other words, the refrigerator car has remained nothing more or less than an ice box on wheels, regardless of the fact that automatic refrigeration with proper temperature regulation has been in continued successful use in storage warehouses for some time. That the service rendered by these wheeled ice boxes has not been of the best is evidenced by the large amounts paid out in claims for perishable freight by the railways in this country.

The need for a refrigerator car that will maintain a constant temperature in the car automatically and for a period of time sufficiently long to eliminate the necessity of attention from the time the car is loaded until it is unloaded has been appreciated by all traffic men and shippers of perishable products for some time. The principles followed by the cold storage warehousemen is probably the best solution of the problem. The Baxter system of car refrigeration, which is controlled by the National Refrigerator Car Company, National Life building, Chicago, follows these principles in that the refrigeration is obtained by the ammonia absorption process and the temperature in the car is automatically regulated by a thermostat. The design and application to the railway car is the invention of William Mack Baxter, formerly of the Illinois Central and the Canadian Pacific. The system is such that a constant temperature anywhere between 32 deg. and 55 deg. F., can be maintained in the car with the outside temperature varying from 55 deg. F., below zero to 105 deg. F. above. Further, as the surrounding temperature drops below that required on the inside of the car the system automatically turns into a heating system by reversing the process of refrigeration.

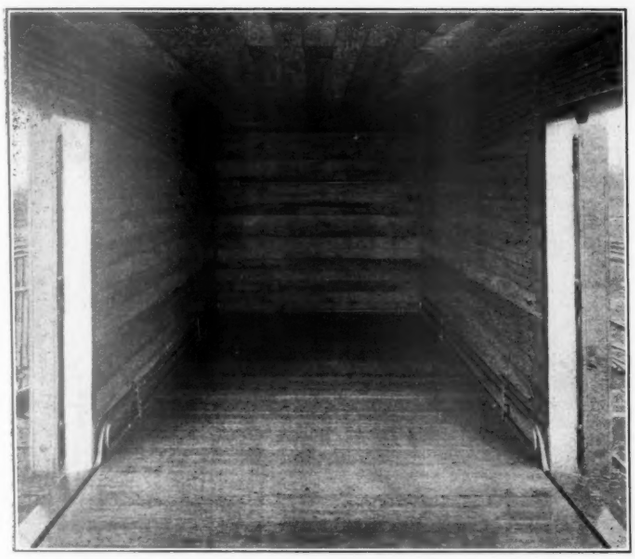
Description of the System.—The system is self-contained and provides its own power. The only work necessary to place the car in operation is to move a lever throwing the system in or out of service, set the thermostat for the temperature desired inside the car and to load the fuel storage magazine once every two weeks. The accompanying illustrations show exterior and interior views of the car, a view of the apparatus, a piping diagram of the car, and a temperature chart giving the record of a day's performance of the car. Briefly, the system used is known as the ammonia absorption process of refrigeration and heating and is applicable to all refrigerator cars, either new or those now in service. The theory of this process is that as a liquid vaporizes it absorbs heat from its surroundings, the amount depending on the latent heat of evaporation. This for ammonia is 555 B. t. u. per pound which, excepting water, is the highest of any medium suitable for refrigerating purposes and hence is the liquid most universally used. Further, ammonia is liquefiable at practical pressures. In the Baxter system there are four distinct stages in the process, whether it be performing the function of refrigeration or heating. These are the generation of ammonia gas, condensation of the gas, expansion of the condensed gas from a liquid back to a gas, and the absorption of the gas in water for regeneration.



Automatic Refrigerator and Heater Car Which Uses the Ammonia Absorption Process

Refrigeration.—The apparatus having been charged with a strong aqua ammonia solution (26 deg. Baume) and the

charcoal magazine filled, a fire is started on the grate *A* to which the charcoal is fed automatically from the magazine which has a capacity of 14 days continuous operation. The ammonia having a lower boiling point than water, is distilled off first leaving behind the water which is now weak in ammonia. The generator *B* is so constructed that practically all of the strong ammonia solution is forced into it by the pump *C*, which by the way is operated by the ammonia gas under pressure, and passes through the generator coil *D*. Here most of the ammonia gas is boiled off collecting at the top of kettle *E* leaving the solution in the kettle weak in ammonia. This fact permits rough switching without causing the liquid to foam.



Interior View Showing Refrigerating Coils Located on Upper Side Walls and Near the Floor

The ammonia gas passes up through the pipe *F* to what is called the analyser, which is a long vertical pipe exposing sufficient surface to condense and precipitate any entrained moisture back to the generator. The gas is then passed through a coil to remove any superheat it may contain before it passes to the condenser *G*. In the condenser the ammonia gas is liquefied ready to be revaporized at the expansion valve *H*. This revaporization produces the refrigeration and the gas as it passes through the refrigerating coils *I* located on the upper side walls of the car, abstracts the heat from the car and its load and passes on to the absorber *J* to be again taken up by the weak water solution. This solution comes from the kettle *E*, passing through the standpipe *K* to the temperature exchanger *L* which is nothing more than a pipe within a pipe. The hot weak liquor passing over the cool, strong solution on its way from the pump to the generator, preheats the latter and cools the former. From *L* the weak liquor passes through spray nozzle *M* into the pump exhaust absorber *N* and absorbs the exhaust ammonia gas from the pump. The solution thus becomes stronger. From there it passes through the radiator *O* where it is cooled and is sprayed into the absorber *J*, as shown in the piping diagram, reuniting with the ammonia gas from the refrigerator coils. From *J* the liquid passes to the pump and is forced into the generator, being preheated at *P* by the heat of the exhaust ammonia gas from the pump, and at *L* as described above. The ammonia gas for driving the pump is taken from the analyser and passes through the pump regulator *Q*. This regulator is of the float type and maintains the liquid in the generator at a predetermined height. The exhaust from the pump passes into the absorber as described above. Thus it will be seen that all the ammonia gas is recollected without loss and the pump is the only moving part of the apparatus. This explains the continuous cycle of operation when the machine is refrigerating. The check valve *R* is interposed in the line leading from the refrigerating coils to the absorber *J* for the purpose of preventing a back surge of the ammonia into the refrigerating coils and killing the frost.

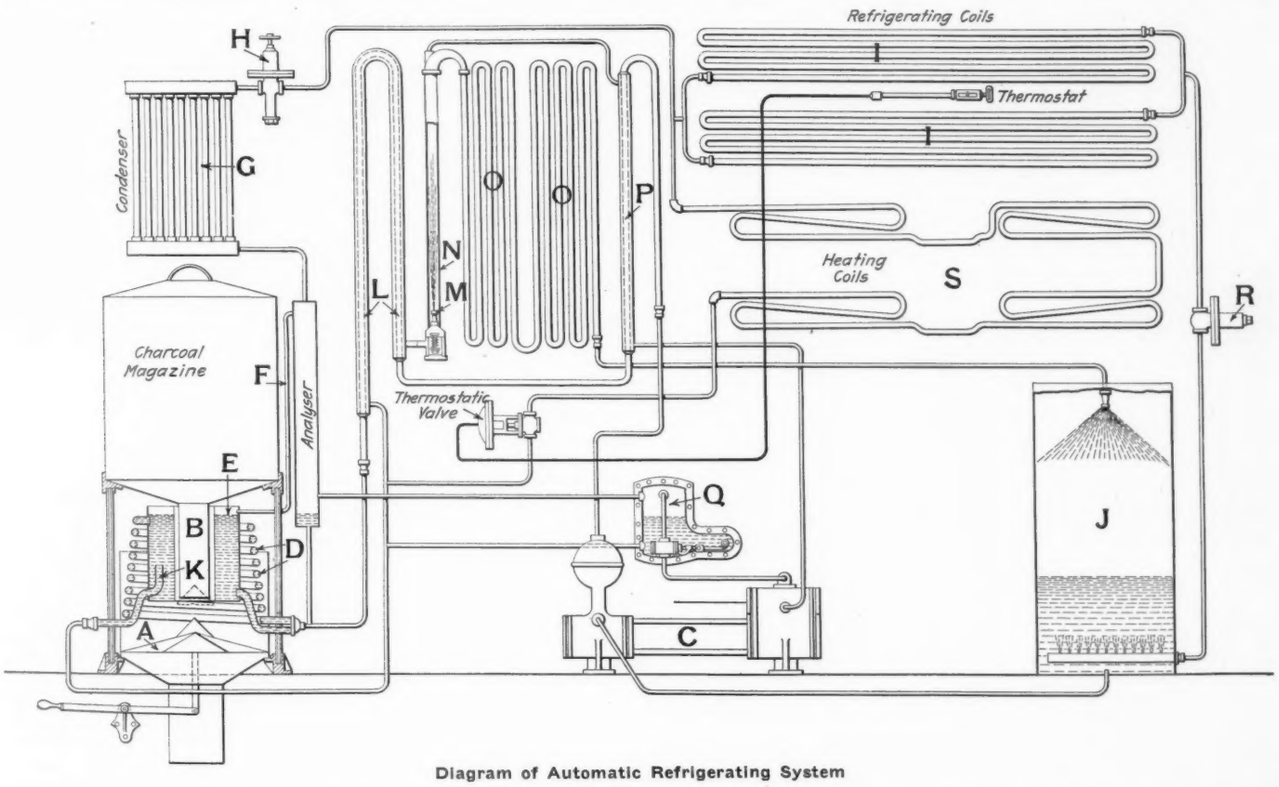


Diagram of Automatic Refrigerating System

Heating.—When the temperature in the car has been low-

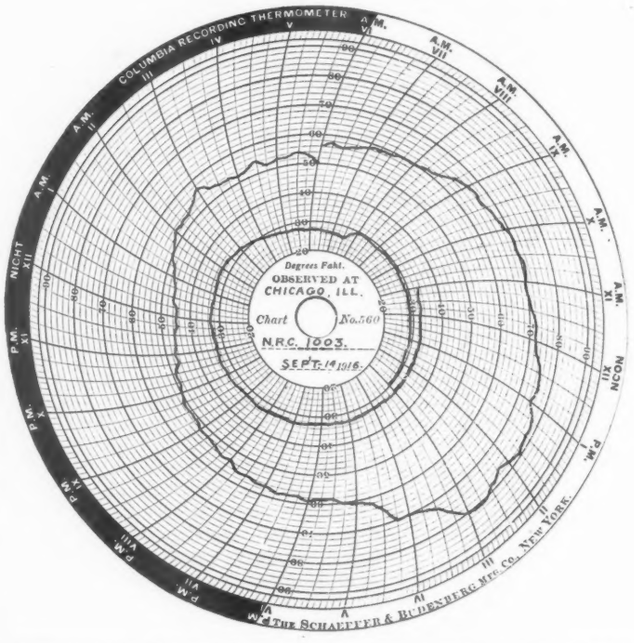
ered below the point for which the thermostat is adjusted, the fluid in the sensitive element of this device contracts and opens the thermostatic valve. This allows hot weak liquor from the generator through the stand pipe *K*, to flow through the heating coils *S* and thus give up its sensible heat. However, this fluid after passing through these coils becomes cool upon completing its course. This fluid is now conducted to the refrigerating coils and, as the automatic expansion valve always remains open in service position, it readily absorbs the ammonia gas coming therefrom in the refrigerating coils which now virtually perform the function of an absorber and throw off the chemical heat of combination known as the heat of absorption. Therefore, heat from two sources is liberated simultaneously within the car to warm it. When the temperature in the car has risen and expanded the fluid in the thermostat sufficiently to close the thermostatic valve, the heating coils *S* become neutral in temperature and the gas continuing to expand through the expansion valve empties the refrigerating coils of the aqua ammonia fluid into the secondary absorber *J*. When they are blown free the expanded gas causes them to again become frosted and the car now operates as a refrigerator.

Location of Parts.—The generator, pump, pump regulator, absorber *J*, and the charcoal magazine are located in one end of the car, as shown in one of the illustrations, occupying a space 4 ft. long from the face of the end sill to the face

End View with End Door and Ventilators Removed to Show Mechanism

of the sheathing of the insulated wall. The refrigerating and heating coils are located at the top and bottom of the sides of the car, respectively, as shown in another illustration. The thermostat is located at the ceiling near the center of the car, and the expansion valve is also inside the car at the end. The condenser *G* is placed underneath the car, together with the temperature exchangers *L* and *P*, the pump exhaust absorber *N* and the absorber radiators *O*. There is another coil of pipe not shown in the piping diagram between the analyzer and the condenser *G*, which is used to remove the superheat from the ammonia gas before it reaches the condenser.

Advantages of the System.—Among the advantages that may be mentioned for this system of transporting perishable freight may be mentioned the automatic feature of obtaining refrigeration or heating as the outside temperature demands; the inside volume of the car will be increased from 6 to 8 per cent over the ice refrigerated cars; the increase in time between chargings; more uniform temperature with less liability for damage to the lading; elimination of the large cost for ice and ice houses, less weight per car than where ice is used, elimination of deterioration of the equipment and tracks caused by brine drippings and a lower car center of gravity. This system will also give a dry atmosphere within the car. This enables certain commodities to be handled



Temperature Chart Showing Range of Inside and Outside Temperatures

with greater safety, as low humidity greatly assists in delaying the process of decomposition. There is also a large reduction in operating costs over other systems, inasmuch as the charcoal consumed costs but 75 cents per day, as compared with the average daily icing cost of $3.75.

The accompanying temperature chart shows how well the inside temperature of the car was maintained with a variation of over 30 deg. in the outside temperature. This test was made on an empty car and is considered a severe test, as the load in a refrigerator car acts as a heat reservoir to smooth out the temperature curve within when any very great variations in outside temperatures are encountered.

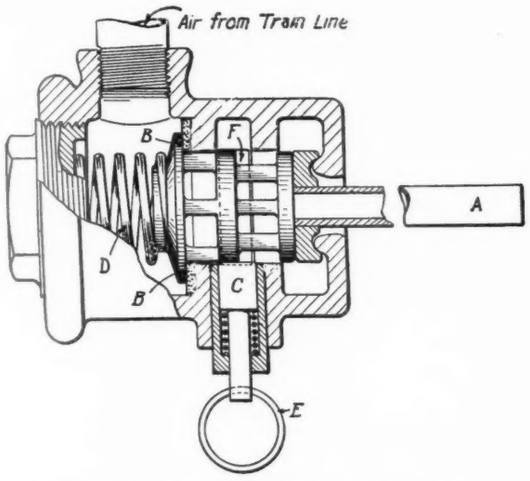
This process will change from a heater to a refrigerator or vice versa as the requirements of the weather and commodities demand, in from two to three hours, and the machine will perform either function in approximately three and one-half hours from the time the fire is lit. This is of material benefit in that it will be unnecessary to hold the equipment ahead of the load for the proper temperature as is now required, with the cars in service today. The car can be used for handling meat, fruits or vegetables without any alteration other than the adjustment of the thermostat and in this respect meets the demands of universal service.

The machine has a capacity of one ton of ice per day, or the equivalent of removing 284,000 B. t. u. in 24 hours, which affords a safe excess over the present ice meltage of standard refrigerator cars. All piping in the car is continously welded and without joints. Those joints shown in the illustration have been eliminated. The weight of the

machine complete with ammonia charge is 5,825 lb. and the concentrated weight at the end of the car of all mechanism including an ammonia charge of 600 lb. and a charcoal charge of 1,400 lb., is 3,900 lb.

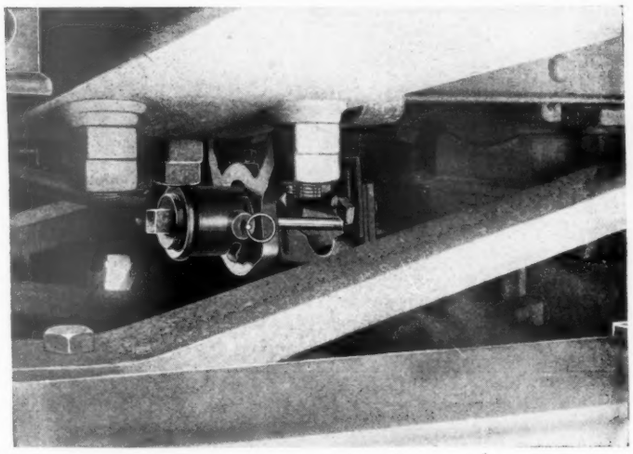
TRUCK SAFETY ATTACHMENT

An attachment the function of which is to set the air brakes automatically whenever the car or tender truck to which it is attached is derailed or becomes broken, has been placed in successful operation on several railroads by the Wright Safety Air Brake Company, Greensboro, N. C. It consists of a valve, attached to the body of the car or tender, connected to the brake pipe underneath. A



Section of Valve for Truck Safety Attachment

section of this valve is shown in one of the accompanying illustrations. It is operated by the pin *A* which is in direct line with the center bearings of the car and extends through an adjustable collar located on the track. As the pin *A* is moved in any direction by this collar it rocks the disc to which the pin is attached, forcing the valve *B* from its seat and allowing air from the brake pipe to pass



Truck Safety Attachment Applied to a Freight Car

out through the opening *F*, thus setting the brakes. If this pin is deflected to any great extent, as it would be in case the truck was derailed, it will force the valve back far enough to allow the plug *C* to spring in behind the valve holding it in the open position. The valve is held in the closed position by the spring *D* and when once opened to its extreme position is reclosed by pulling out the plug *C* by means of the ring *E*.

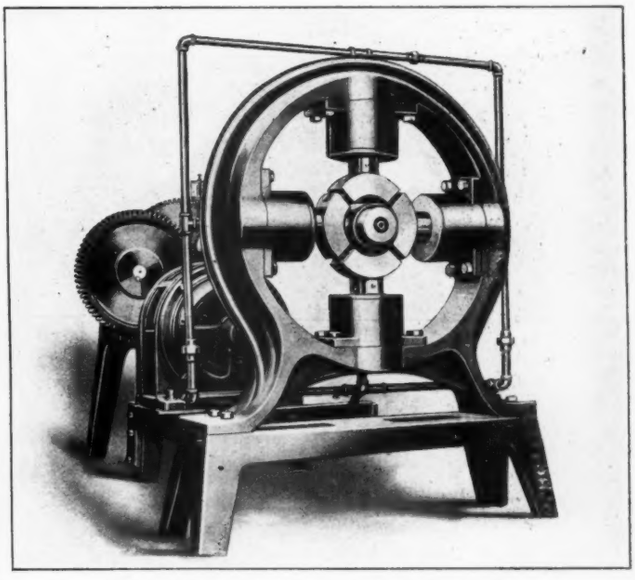
The collar surrounding the pin *A* is adjusted to suit the conditions in which the car operates so that the device will not be operated by the normal movement of the truck. This movement may be taken by test, a pencil replacing the pin and a chart the collar. The record of the movement of a baggage car truck is shown in one of the illustrations. This device has been installed on several railroads where it has prevented serious wrecks by stopping the train when

Record of the Movement of a Baggage Car Truck with Reference to the Car Body (slightly over full size)

the truck to which it was applied became defective. It will operate whenever the trucks leave the rails whether due to a broken rail, spread rails or for any other reason. It will also be operated by a broken journal, arch bar or spring, by splitting a switch, or by any other abnormal condition affecting the movement of the truck and threatening the safe progress of the train.

UNIVERSAL TUBE WELDER

Flue welders, which roll the tubes from the outside, have a tendency to reduce the inside diameter at the weld, and the reduced diameter at the weld has a tendency to increase the resistance to the free passage of the hot gases through the tubes. With this in mind, the Southwark Foundry &



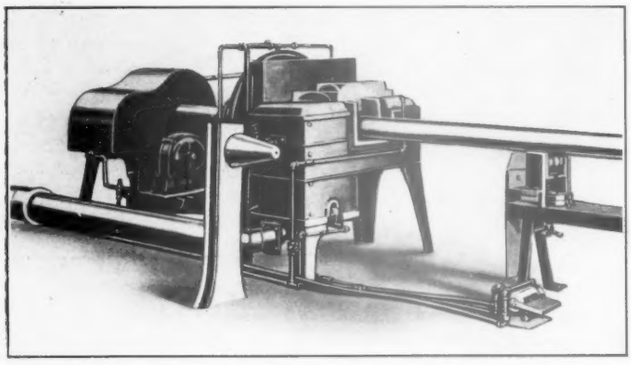
Universal Flue Welder With Furnace Removed

Machine Company, Philadelphia, Pa., has designed a universal flue welder which rolls the flues from the inside.

The illustration of the front of the welder shows four air cylinders, all piped together and working simultaneously. The pistons in these cylinders operate the clamping heads which hold the flue against the welding mandrel. The mandrel, which is hollow, fits inside the tube and on it are assembled four tapered rollers. These rollers are free in their bearings and can be moved radially by inserting a

taper mandrel that reaches through the center of the spindle from the back of the machine. This mandrel is operated by means of an air cylinder controlled by the main foot valve.

A furnace is located directly in front of the welding mandrel. This is done in order that there may be as little heat lost as possible in transferring the tube to the welding machine and also to cut down to a minimum the time necessary for the transfer. A cast iron tank, or water back, protects the welding head from excessive heat from the furnace.



Universal Flue Welder and Furnace Complete

The size of the mandrel back of the welding rollers approximates the inside diameter of the flue and supports the weight of the safe end while being heated and moved to the welding position.

The operator uses a foot valve which controls the entire operation of the welder. The piping is so arranged that the clamping heads close in on the outside diameter of the flue before the taper mandrel expands the rollers to make the weld. Driven directly from the motor, the mandrel is started by an air chuck operating automatically with the clamping of the flue. The main mandrel is driven through two gear reductions by a 1½-hp. motor. This motor is mounted on the framework underneath the gearing and takes up very little space. Cut gears are used throughout.

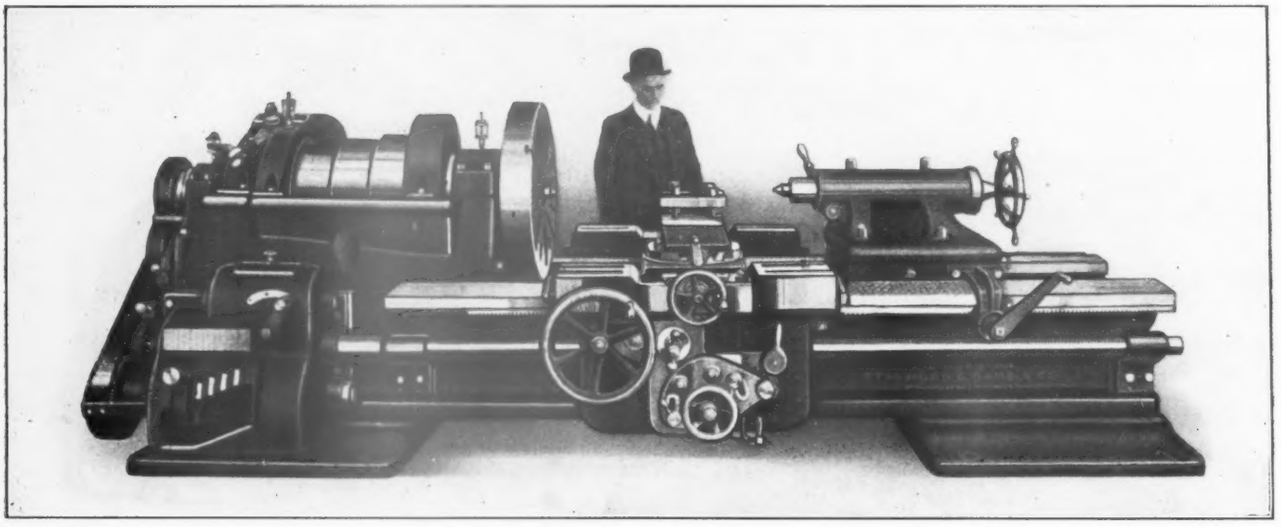
It is estimated by the builders that one crew can easily weld in a day of 10 hours, 120 superheater flues, the machine having a capacity up to 5½-in. flues. The air pressure required is 80 to 100 lb. and the floor space occupied 3 ft. 6 in. by 9 ft.

HEAVY DUTY ENGINE LATHE

A heavy duty lathe recently placed on the market by the Houston, Stanwood & Gamble Company, Cincinnati, Ohio, is shown in the illustration. This lathe was developed to meet a heavy demand for a high-grade tool of large swing and great power. It has a swing of 30½ in. over the V's and 18¼ in. over the bridge. The carriage is 44 in. long and the bridge width 16 in. The lathe has a 30-in. face plate, all gears are of steel and the important bearings are thoroughly bushed, bronze bushings being used on the front and rear spindle bearings. Both head and tailstock are carried on the rear V's. The tailstock is of the set over pattern and in addition to four accessible bolts, is held by a pawl engaging a rack cast in the bed, midway between the V's. The tailstock spindle is 4¼ in. in diameter and has a travel of 12 in.

This lathe is of the double back-geared type and, when belt driven, is fitted with a three-step cone designed to fit a belt six in. wide. The ratio produced by the two back-gear reductions is 3.55 and 12.5, respectively, and with counter shaft speeds of 243 and 128 revolutions per minute, a total of 18 spindle speeds is available, varying from 8.3 r. p. m. to 300 r. p. m. With a counter shaft speed of 243 revolutions per minute and the belt on the middle step of the cone, 16 hp. is transmitted to the lathe.

The carriage is guided by the front V, which is of the broad, low-angle type. A range of from 1 to 14 threads per inch may be obtained without additional feed gears. Between 1 and 1½ threads per inch, the steps are by eighths of a thread per inch. From 1½ to 3 threads per inch, the steps are by quarters, from 3 to 6 by halves, while from 6 to 14, the steps are one thread per inch. Twenty-four feeds are provided without gear changes. By the use of additional gear changes any United States standard thread or metric thread, and any feed, may be obtained. When specified, a housing is furnished covering the entire top of the headstock, to receive a motor for motor drive. Any length of bed desired can be furnished up to 30 ft. When mounted on skids and equipped with motor drive (excluding the weight of the motor) the lathe with the minimum length bed weighs approximately 18,000 lb.



Heavy Duty Double Back Gear Engine Lathe

Pig Iron Production.—The total pig iron production in the United States for the first half of 1916 was 19,610,522 tons. The production of pig iron in Canada during the same period was 507,750 tons.

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WE GUARANTEE, that of this issue 8,850 copies were printed; that of these 8,850 copies 7,623 were mailed to regular paid subscribers, 118 were provided for counter and news companies' sales, 555 were mailed to advertisers, exchanges and correspondents, and 554 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 100,450, an average of 8,371 copies a month.

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The executive committee of the Master Car Builders' Association has issued Circular No. 14, stating that on account of labor and material delays the date at which the tank car specifications for Class III and IV tank cars were to become effective, has been extended 60 days, to March 1, 1917.

At the Reading (Pa.) shops of the Philadelphia & Reading last Saturday afternoon the general manager, Charles H. Ewing, presented to the Reading shop baseball team the A. T. Dice cup. This team won the pennant in competition with several other Reading system teams during the past season. There was music by the shop band, and singing by some of the shopmen.

Asa Farrar, claim adjuster of the Seaboard Air Line, has secured a patent on a locking arrangement for switch stands to be used for the benefit of car repairers. Repairers, to insure their own safety when working under cars on the repair tracks, lock the switch leading to that track with a padlock. The repair man has in his possession the only key to the lock; and Mr. Farrar's device is to provide for the employment of this safeguard by any number of repair men at the same time. The switch having been locked by each of the men with his individual lock, it cannot be again moved until all of the locks which have been put on it have been released.

The Railway Engineering Experimental Station of the University of Illinois has made arrangements with the International Railway Fuel Association and the United States Bureau of Mines to conduct a series of coal tests in the locomotive testing plant, the Baltimore & Ohio having loaned a Mikado type freight locomotive for that purpose. This locomotive weighs with its tender, a total of 464,000 lb. and has a tractive effort of 54,000 lb. Samples of coal to be used will be taken from Illinois mines and will be graded according to the present commercial sizes, ranging from the so-called slack and run-of-mine, up to the commonly used

2-in. by 6-in. lumps. The tests will be made both with hand and stoker firing, and later it is the intention to conduct a series of tests with pulverized coal.

The Southern Pacific has awarded 78 gold watch fobs, suitably engraved and bearing the company's safety emblem, to employees who did the most towards furthering "safety first" work during the past fiscal year. C. H. Rippon, piecework inspector at the general shops at Sacramento, Cal., headed the list with a score of 1,293 points. Ten and one-half points are granted for each safety suggestion made involving a change in standard practice to correct a defect the practical working out of which requires actual labor, and indicates the thoughtful attention of the employee. For each suggestion which warrants the issuance of instructions to employees, but does not involve physical labor in its application, five points are given. One credit is granted for each suggestion not involving actual labor in its application, and which heretofore has been covered by instructions.

A CORRECTION

In the report of the Chief Interchange Car Inspectors' & Car Foremen's Association published in the November issue of the *Railway Mechanical Engineer*, page 571, some remarks under the heading of Discussion of Interchange Rules were attributed to F. H. Hansen of the New York Central, and S. Hanson of the Peoria & Pekin Union, which were made by William Hansen, chief joint inspector, at Denver, Colo. William Hansen spoke on Rule 3, Section C, Rule 9 and Rule 98.

CARS AND LOCOMOTIVES ORDERED IN NOVEMBER

As noted elsewhere in this issue the orders for cars and locomotives reported in November exceeded those for any other month in the last three years, there having been orders reported as follows:

	Locomotives	Freight Cars	Passenger Cars
Domestic	408	44,001	510
Foreign	755	.....	...
Total	1,163	44,001	510

So many large orders were reported during the month that space will permit only the notation of some of the more important ones. Among the locomotive orders were included the following:

Road	No.	Type	Builder
Atlantic Coast Line	5	Switching	Baldwin
	20	Pacific	Baldwin
Chicago & North Western	25	Mikado	American
	12	Pacific	American
	40	Switching	American
El Paso & Southwestern	10	Pacific	American
Erie	15	Santa Fe	American
Florida East Coast	10	Pacific	American
	2	Switching	American
Missouri, Kansas & Texas	10	Pacific	American
New York, Chicago & St. Louis	25	Mikado	American
	20	Switching	Lima
Norfolk & Western	8	Mountain	Company shops
	1	Mallet	Company shops
Southern	12	Mallet	Baldwin
	8	Mountain	Baldwin
	25	Santa Fe	Baldwin
Union Pacific	16	Santa Fe	Baldwin
	20	Mikado	Baldwin
Wabash	25	Santa Fe	American
British Government	450	4-6-0	Baldwin
French Government	100	.....	Baldwin
Italian State Railways	40	Consolidation	American
Norwegian Railways (various)	22	.....	Baldwin
Paris-Lyons Mediterranean (France)	40	Mikado	Baldwin
Russian Government	40	Decapod	American
	40	Decapod	Baldwin
	20	Decapod	Canadian

Among the important orders for freight cars were the following:

Road	No.	Type	Builder
Atlantic Coast Line	1,200	Box	Barney & Smith
	500	Flat	Barney & Smith
Atchison, Topeka & Santa Fe	500	Tank	Pressed Steel
	1,000	Stock	Haskell & Barker
Baltimore & Ohio	2,000	Box	Mt. Vernon
Cambria & Indiana	1,000	Hopper	Cambria
Chicago, Burlington & Quincy	500	Gondola	Western Steel
	1,000	Automobile	Haskell & Barker
	2,000	Box	Haskell & Barker
Delaware, Lackawanna & Western	500	Box	Am. C. & F.
	500	Hopper	Am. C. & F.
Erie	1,000	Box	Haskell & Barker
	1,000	Box	Am. C. & F.
Great Northern	1,000	Box	Pressed Steel
	500	Automobile	Haskell & Barker
	500	Refrigerator	Haskell & Barker
	500	Refrigerator	Refrig., Heat. & Vent. Car
Illinois Central	400	Ballast	Rodger
	1,000	Gondola	Pullman
	1,000	Gondola	Haskell & Barker
Louisville & Nashville	750	Box	Company shops
	750	Gondola	Company shops
	1,000	Gondola	Mt. Vernon
	1,000	Gondola	Company shops
Minneapolis, St. Paul & S. S. Marie	800	Box	Haskell & Barker
	200	Automobile	Haskell & Barker
Missouri, Kansas & Texas	1,000	Stock	Am. C. & F.
Philadelphia & Reading	1,000	Hopper	Cambria
	500	Hopper	Pressed Steel
	500	Hopper	Standard Steel
Southern	1,313	Gondola	Pressed Steel
	1,350	Box	Lenoir
	500	Stock	Lenoir
	100	Caboose	Lenoir
Union Railroad	1,250	.....	Pressed Steel
	750	Gondola	Ralston
Union Pacific	1,500	Box	Am. C. & F.
	1,000	Automobile	Ralston
Wabash Pittsburgh Terminal	1,000	Hopper	Pressed Steel

The New York Central's order for 300 passenger train cars is the largest order for steam railway passenger equipment for a very long time. There were also other important orders in November.

Road	No.	Type	Builder
Baltimore & Ohio	75	Coaches	Pullman
	25	Combination	Pullman
New York Central	50	Coaches	Pressed Steel
	25	Coaches	Barney & Smith
	25	Baggage	Pullman
	125	Baggage	Am. C. & F.
	75	Coaches	Standard Steel
Norfolk & Western	22	Coaches	Har. & Holl.
	28	Combination	Har. & Holl.
Western Maryland	17	Coaches	Pullman
	6	Combination	Pullman
	2	Café	Pullman

MEETINGS AND CONVENTIONS

Air Brake Association.—The 24th annual convention of the Air Brake Association will be held at Memphis, Tenn., May 1-4, 1917.

The June Mechanical Conventions.—Atlantic City has been chosen by the executive committees of the Master Car Builders and the Master Mechanics' associations as the place for holding the 1917 conventions. The Master Mechanics' Association convention will be held first this year, starting on Wednesday, June 13. The Master Car Builders will follow, commencing Monday, June 18. The vote as to whether the convention should go to Chicago or Atlantic City was especially close this year, and the question was only decided after an extended discussion by the two executive committees sitting in executive session. The Chicago Chamber of Commerce presented an able argument, offering the associations the exclusive use of the Municipal Pier for both the exhibits and the convention.

President Edmund H. Walker, of the Railway Supply Manufacturers' Association, has appointed the following committees:

Exhibit committee, J. G. Platt (chairman), Hunt-Spiller Manufacturing Corporation; George R. Carr, Dearborn Chemical Company, and C. W. Beaver, Yale & Towne Manufacturing Company.

Finance committee, J. F. Schurch (chairman), Damascus Brake Beam Company; George H. Porter, Western Electric Company, and William McConway, Jr., McConway & Torley Company.

Hotel committee, George H. Porter (chairman), Western Electric Company; C. P. Cass, Westinghouse Air Brake Company, and H. G. Thompson, Edison Storage Battery Company.

Badge committee, C. D. Eaton (chairman), American Car & Foundry Company; C. W. Beaver, Yale & Towne Manufacturing Company, and George A. Cooper, Frost Railway Supply Company.

By-laws and resolutions committee, P. J. Mitchell (chair-

man), Philip J. Justice & Co.; Frank Beal, Magnus Metal Company, and C. P. Cass, Westinghouse Air Brake Company.

Entertainment committee, E. H. Bankard, Jr. (chairman), Midvale Steel Company.

Enrollment committee, Charles H. Gayetty (chairman), Quaker City Rubber Company.

Transportation committee, L. S. Wright (chairman), National Malleable Castings Company.

Committees for the Master Mechanics' Association.—The committees for the Master Mechanics' Association, which are to report at the 1917 convention, have been appointed. The following four special committees, which reported last year, have been discontinued: Equalization of Long Locomotives, Dimensions of Flange and Screw Couplings for Injectors, Best Design and Material for Pistons, Valves, Rings and Bushings and Modernizing of Existing Locomotives. A new special committee has been appointed to report on Springs—Shop Manufacture and Repair, Including Design, Appliances and Repairs. The committees on Powdered Fuel and Specifications and Tests for Materials, which reported as special committees last year, have been made standing committees.

The personnel of the committees remains practically the same, there being two new members added to the standing committee on Powdered Fuel, one to the special committee on Locomotive Headlights, two to the special committee on Design, Maintenance and Operation of Electric Rolling Stock, and one to the committee on Train Resistance and Tonnage Rating. The special committee on Co-operation with Other Railway Mechanical Organizations has been practically revised, only two of the members serving last year remaining on the committee this year. The following is a list of the committees and their personnel:

STANDING COMMITTEES

1. *Standards and Recommended Practice:*

W. E. Dunham (Chairman), Supr. M. P. & M., C. & N. W.; M. H. Haig, M. E., A. T. & S. F.; A. G. Trumbull, Asst. to G. M. S., Erie; C. D. Young, Engr. Tests, Penna.; G. S. Goodwin, M. E., C. R. I. & P.; R. L. Ettenger, C. M. E., Southern; B. B. Milner, Engr. M. P., N. Y. C.

2. *Mechanical Stokers:*

A. Kearney (Chairman), A. S. M. P., N. & W.; M. A. Kinney, S. M. P., Hocking Valley; J. R. Gould, S. M. P., C. & O.; J. T. Carroll, A. G. S. M. P., Balto. & Ohio; J. W. Cyr, S. M. P., C. B. & Q.; A. J. Fries, A. S. M. P., N. Y. Central Lines; L. B. Jones, A. E. M. P., Penna.

3. *Fuel Economy and Smoke Prevention:*

Wm. Schlafge (Chairman), G. M. S., Erie; W. H. Flynn, S. M. P., Mich. Central; D. M. Perine, S. M. P., Penna; Robert Quayle, G. S. M. P. & C., C. & N. W.; D. J. Redding, A. S. M. P., P. & L. E.; W. J. Tollerton, G. M. S., C. R. I. & P.; F. H. Clark, G. S. M. P., B. & O.

4. *Powdered Fuel:*

C. H. Hogan (Chairman), A. S. M. P., N. Y. C.; E. W. Pratt, A. S. M. P., C. & N. W.; Thos. Roope, S. M. P., C. B. & Q.; J. H. Manning, S. M. P., D. & H.; Charles James, M. S., Erie; G. L. Fowler, 83 Fulton street, New York City; W. L. Kellogg, S. M. P., M. K. & T.; O. S. Beyer, University of Illinois, Urbana, Ill.

5. *Specifications and Tests for Materials:*

C. D. Young (Chairman), Engr. Tests, Penna.; J. R. Onderdonk, Engr. Tests, B. & O.; A. H. Fetters, M. E., Union Pac.; Frank Zeleny, Engr. Tests, C. B. & Q.; H. E. Smith, Engr. Tests, N. Y. C.; H. B. MacFarland, Engr. Tests, A. T. & S. F.; Prof. L. S. Randolph, Virginia Polytechnic Institute, Blacksburg, Va.

SPECIAL COMMITTEES

6. *Design and Maintenance of Locomotive Boilers:*

C. E. Fuller (Chairman), S. M. P., Union Pacific; A. W. Gibbs, C. M. E., Penna.; D. R. MacBain, S. M. P., New York Central; M. K. Barnum, S. M. P., Balto. & Ohio; R. E. Smith, G. S. M. P., Atlantic Coast Line; C. B. Young, M. E., Chgo. Bur. & Quincy; J. Snowden Bell, New York City.

7. *Locomotive Headlights:*

D. F. Crawford (Chairman), G. S. M. P., Penna. Lines; C. H. Rae, G. M. M., L. & N.; F. A. Torrey, G. S. M. P., C. B. & Q.; H. T. Bentley, S. M. P. & M., C. & N. W.; M. K. Barnum, S. M. P., Balto. & Ohio; Henry Bartlett, G. M. S., B. & M.; W. H. Flynn, S. M. P., Mich. Central; W. O. Moody, M. E., Illinois Central; A. R. Ayers, S. M. P., N. Y. C. & St. L.

8. *Superheater Locomotives:*

W. J. Tollerton (Chairman), G. M. S., C. R. I. & P.; H. W. Coddington, Engr. Tests, N. & W.; C. H. Hogan, A. S. M. P., N. Y. C. & H. R.; R. W. Bell, G. S. M. P., Ill. Cent.; T. Roope, S. M. P., C. B. & Q.; W. C. A. Henry, S. M. P., Penna. Lines; E. W. Pratt, A. S. M. P., C. & N. W.; G. M. Basford, 30 Church street, New York City.

9. *Design, Maintenance and Operation of Electric Rolling Stock:*

C. H. Quereau (Chairman), New York Central; G. C. Bishop, S. M. P., Long Island; G. W. Wildin, M. S., N. Y. N. H. & H.; J. H. Davis, E. E. B. & O.; R. D. Hawkins, S. M. P., Great Northern; A. E. Manchester, S. M. P., C. M. & St. P.; T. W. Heintzelman, G. S. M. P., Southern Pacific; J. T. Wallis, G. S. M. P., Penna.; J. E. Pilcher, M. E., N. & W.

10. *Coöperation with Other Railway Mechanical Organizations:*

D. R. MacBain (Chairman), S. M. P., New York Central; E. W. Pratt, A. S. M. P., C. & N. W.; C. A. Shaffer, G. T. I., Illinois Central; F. J. Barry, M. M., N. Y. O. & W.; E. S. Fitzsimmons, M. S., Erie; F. C. Pickard, M. M., D. L. & W.

11. *Train Resistance and Tonnage Rating:*

O. C. Wright (Chairman), A. E. M. P., Penna. Lines; H. C. Manchester, S. M. P., D. L. & W.; C. E. Chambers, S. M. P., C. R. R. of N. J.; J. H. Manning, S. M. P., D. & H.; Frank Zeleny, Engr. Tests, C. B. & Q.; Prof. E. C. Schmidt, University of Illinois, Urbana, Ill.; Jos. Chidley, A. S. M. P., N. Y. C.; J. T. Carroll, A. G. S. M. P., B. & O.

12. *Springs—Shop Manufacture and Repair, Including Design, Appliances and Repair:*

M. F. Cox (Chairman), A. S. M., L. & N.; Eliot Sumner, S. M. P., Penna.; A. G. Trumbull, Asst. to G. M. S., Erie; E. W. Pratt, A. S. M. P., C. & N. W.; T. A. Foque, G. M. S., M. St. P. & S. S. M.; C. A. Gill, G. M. M., B. & O.; G. W. Rink, M. E., C. R. R. of N. J.

13. *Subjects:*

M. K. Barnum (Chairman), S. M. P., B. & O.; D. R. MacBain, S. M. P., New York Central; C. E. Fuller, S. M. P., Union Pacific.

14. *Arrangements:*

Wm. Schlafge, G. M. S., Erie; C. E. Chambers, S. M. P., C. R. R. of N. J.; E. H. Walker, Standard Coupler Co.

Individual Papers:

Feed Water Heaters, by J. Snowden Bell; Welding Locomotive Tubes, Fire Box and Boiler Sheets, by D. R. MacBain.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

AIR BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Convention, May 1-4, 1917, Memphis, Tenn.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—O. E. Schlink, 485 W. Fifth St., Peru, Ind.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.—J. W. Taylor, Karpen Building, Chicago.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—Owen D. Kinsey, Illinois, Central, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Annual Meeting, December 5-8, 1916, New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 Lawlor Ave., Chicago. Second Monday in month, except June, July and August, Hotel La Salle, Chicago.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—W. R. McMunn, New York Central, Albany, N. Y.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, C., H. & D., Lima, Ohio.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. G. Crawford, 547 W. Jackson Blvd., Chicago. Convention, May, 1917, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1126 W. Broadway, Winona, Minn.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York.

MASTER CAR BUILDERS' ASSOCIATION.—J. W. Taylor, Karpen Building, Chicago.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—E. N. Frankenberger, 623 Brisbane Building, Buffalo, N. Y. Meetings, third Wednesday in month, New York Telephone Bldg., Buffalo, N. Y.

RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio.

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian	Dec. 12, 1916	Notes on Heavy Electric Traction	J. A. Shaw	James Powell	P. O. Box 7, St. Lambert, Que.
Central	Jan. 12, 1917	Annual Meeting; Election of Officers		Harry D. Vought	95 Liberty St., New York.
Cincinnati	Feb. 13, 1917	Demonstration of the Automatic Stop	Julian Beggs	H. Boutet	101 Carew Bldg., Cincinnati, Ohio.
New England	Dec. 12, 1916			Wm. Cade, Jr.	683 Atlantic Ave., Boston, Mass.
New York	Dec. 15, 1916	Annual Smoker and Entertainment		Harry D. Vought	95 Liberty St., New York.
Pittsburgh				J. B. Anderson	207 Penn Station, Pittsburgh, Pa.
Richmond	Dec. 11, 1916	Electric Headlights	L. C. Porter	F. O. Robinson	C. & O. Railway, Richmond, Va.
St. Louis	Dec. 11, 1916	Address and Annual Entertainment	A. Ross Hill	B. W. Frauenthal	Union Station, St. Louis, Mo.
South'n & S'w'rn.	Jan. 19, 1917			A. J. Merrill	Box 1205, Atlanta, Ga.
Western	Dec. 18, 1916			Jos. W. Taylor	1112 Karpen Bldg., Chicago.

PERSONAL

GENERAL

M. J. Flanigan, who was recently appointed master mechanic of the Minot division of the Great Northern at Minot, S. Dak., has been appointed general master mechanic with headquarters at Great Falls, Mont.

H. G. Reid, heretofore master mechanic, district 3, Transcontinental division of the Canadian Government Railways at Transcona, Man., has been appointed assistant superintendent of rolling stock with headquarters at that point, having direct charge of the Transcona shops, and will perform such other duties as may be assigned to him.

F. W. Taylor, superintendent of motive power of the International & Great Northern, has been appointed superintendent of motive power of the Missouri, Kansas & Texas, at Denison, Texas, effective February 1, 1917, succeeding W. L. Kellogg, who has resigned, effective at that time.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

John Birse, road foreman of locomotives of the Canadian Government Railways at Graham, Ont., has been appointed district master mechanic, district 3, Transcontinental division, with headquarters at Transcona, Man., and his former position has been abolished.

Albert H. Kendall, whose appointment as master mechanic of the Canadian Pacific was announced in the November issue of the *Railway Mechanical Engineer,* was born at Aspatria, Cumberland, England, on April 4, 1878, and began his railroad career in June, 1901, with the Canadian Pacific as machinist at Revelstoke. He remained in this capacity until March, 1902, when he became locomotive foreman at Nakusp, B. C. From January, 1903, to December, 1903, he was general foreman at Revelstoke, then leaving the Canadian Pacific to become locomotive foreman for the Grand Trunk at London, Ontario. In December, 1904, he returned to the Canadian Pacific and later was appointed general erecting foreman at the Angus shops. In April, 1915, he became general foreman at North Bay, Ont., and in August, 1916, was made assistant works manager at the Angus shops. He had the latter position at the time of his appointment as master mechanic.

A. H. Kendall

F. A. Butler has been appointed master mechanic of the Albany division of the Boston & Albany, which includes the main line and branches between Springfield, Mass., and Albany, N. Y., succeeding J. B. Canfield, assigned to other duties. Mr. Butler was born in Shrewsbury, Mass., September 21, 1868. He entered the service of the Boston & Albany at Springfield in June, 1892, as a locomotive fireman, became locomotive engineer in November, 1898, and was appointed road foreman of engines of the Boston division in June, 1908. He was made master mechanic of the Boston division in August, 1910, so continuing until November 1, 1916, when he was appointed master mechanic of the Albany division at West Springfield, Mass.

B. J. Farr, general foreman of the Grand Trunk, who was recently promoted to master mechanic, with office at Battle Creek, Mich., graduated from the high school at St. Albans, Vt., in 1893, and immediately entered railway service with the Central Vermont as a machinist apprentice. Later he was promoted to erecting shop foreman, and general foreman of the shop with this same company. In 1907 he left the service of the Central Vermont to accept a position on the Northern Railway of Costa Rica, where he remained until 1909. About this time the opportunity to acquire broader railroad experience presented itself, and he resigned to enter government service on the Panama Railroad at the time the Panama Canal was being constructed. He served in various capacities with this company until 1914, when he returned to the United States and entered the service of the Grand Trunk as general foreman in January, 1915. His present appointment as master mechanic became effective October 1, 1916.

F. A. Hussey has been appointed master mechanic of the Boston division of the Boston & Albany, with headquarters at Beacon Park, Allston, Mass., succeeding F. A. Butler, promoted. Mr. Hussey was born at Lynn, Mass., February 12, 1870. He entered the service of the Boston & Albany at Boston, in July, 1892, as a locomotive fireman and was promoted to locomotive engineer in December, 1902. He was appointed road foreman of engines of the Boston division of the Boston & Albany in April, 1913, holding the latter position at the time of his recent appointment.

Charles Leat has been appointed road foreman of engines on the Atchison, Topeka & Santa Fe, Eastern division, with office at Argentine, Kan., succeeding A. F. Bauer.

William B. Smith has been appointed road foreman of engines on the Boston division of the Boston & Albany with headquarters at Beacon Park yard, Allston, Mass., succeeding F. A. Hussey, promoted. Mr. Smith has been a locomotive engineer on the Boston & Albany since 1897.

CAR DEPARTMENT

Frank S. Bogan, formerly assistant car foreman of the Illinois Central, has been appointed general car foreman at Clinton, Ill.

W. A. Carter, formerly passenger car foreman of the Illinois Central, has been appointed steam heat and air brake inspector of the Southern lines with office at Memphis, Tenn.

R. D. McCullough, formerly gang foreman of the Illinois Central, has been appointed assistant car foreman at Centralia, Ill.

James Porteous, heretofore car inspector for the Grand Trunk Pacific at Smithers, B. C., has been appointed car foreman at that point, succeeding F. E. Dymond, transferred.

SHOP AND ENGINEHOUSE

John D. Rogers, recently appointed superintendent of shops of the Virginian Railway with headquarters at Princeton, W. Va., was born at Lexington, Va., on December 31, 1896. He graduated from the Virginia Polytechnic Institute in 1906 and in the same year entered the service of the Chesapeake & Ohio as a machinist apprentice. Later, until 1909, he was a machinist for the Virginian Railway. He graduated as a mechanical engineer from Cornell University in 1909 and subsequently, until 1911, was inspector of new cars and material for the Virginian Railway, from 1911 to 1912 serving as inspector of new locomotives at the works of the builders. In 1912 he was appointed roundhouse foreman of the Virginian Railway, leaving this road in 1915 to enter the service of the Oregon Short Line at Pocatello, Idaho, in a similar capacity. In June, 1916, he became general foreman of the Pere Marquette at Detroit, Mich., and in September, 1916, again entered the service of the Virginian Railway, as superintendent of shops.

WILLIAM J. TRACY has been appointed superintendent of shops of the Lehigh Valley at Sayre, Pa., succeeding J. C. Seeger, who has resigned. Mr. Tracy, who is a native of Wilkes-Barre, was an apprentice and learned his trade as a machinist in the old Wilkes-Barre shops of the Lehigh Valley. In 1904 he left this road to go to the Southern Railway where he became a foreman in the shops at Atlanta, later being appointed master mechanic of the Atlanta division. In 1905 he went to the Louisville & Nashville as master mechanic and shop superintendent at South Louisville, Ky., opening and organizing the shops at that point. In 1908 Mr. Tracy was appointed assistant superintendent of motive power of the Missouri Pacific at Kansas City, where he remained until January 31 of this year, when he left the service of the Missouri Pacific. He took up his new duties on November 1.

PURCHASING AND STOREKEEPING

C. D. CLAPP has been appointed purchasing agent of the Mississippi Central, with office at Hattiesburg, Miss.

W. R. CULVER, storekeeper of the Pere Marquette at Grand Rapids, Mich., has been appointed general storekeeper. The office of general storekeeper is now located at Saginaw, Mich.

J. P. HARRISON, assistant purchasing agent of the Louisville & Nashville, at Louisville, Ky., has been appointed purchasing agent, succeeding P. P. Huston, retired.

H. T. SHANKS has been appointed assistant purchasing agent of the Louisville & Nashville, at Louisville, Ky., succeeding J. P. Harrison, who has been promoted.

P. J. SHEA has been appointed general storekeeper of the Boston & Albany, with headquarters at West Springfield, Mass., succeeding E. B. Rockwood, resigned.

M. E. TOWNER has been appointed purchasing agent of the Western Maryland, with headquarters at Baltimore, Md. Mr. Towner was born October 3, 1875, at Branford, Conn., where he received his early education. He entered railway service on September 1, 1894, with the New York, New Haven & Hartford, in the general auditing department at New Haven, Conn., being transferred to New York City on July 1, 1902, as a clerk in the purchasing department. On May 31, 1907, he was appointed assistant to the vice-president of the Chicago, Rock Island & Pacific at Chicago, Ill., and on July 3, 1908, became purchasing agent of the St. Louis & San Francisco, at St. Louis, Mo. He resigned this latter connection in July, 1910, to assume the presidency of the Southern Railway Supply Company. On May 1, 1914, he was appointed special representative of the Whitman & Barnes Company, with offices at St. Louis, Mo., which position he held at the time of his appointment as purchasing agent of the Western Maryland, on November 1.

M. E. Towner

OBITUARY

WILLIAM ARNOLD ANGELL, formerly purchasing agent of the Pullman Company, and before that for many years first assistant to the late George M. Pullman, died at his home in Chicago on the evening of November 14, aged 84 years.

THEODORE N. ELY, formerly chief of motive power of the Pennsylvania Railroad System, including the lines both east and west of Pittsburgh and Erie, whose death was announced in these columns last month, was born June 23, 1846, at Watertown, N. Y., and was graduated from the Rensselaer Polytechnic Institute in 1866, as a civil engineer. Immediately after graduation he was engaged as an engineer at the old Fort Pitt foundry at Pittsburgh, experimenting with projectiles. A year later, 1867, he was at work in mining operations in the Monongahela river region. In 1868 he entered upon his long career in the service of the Pennsylvania Railroad as an engineer in the roadway department on the Pittsburgh, Fort Wayne & Chicago at Pittsburgh, from which he was soon sent as assistant engineer to the Philadelphia & Erie division of the Pennsylvania. In 1869 and 1870 he was superintendent of the Middle division of the Philadelphia & Erie, and was then promoted to assistant general superintendent, a position which he held until 1873. From 1873 to 1874 he was superintendent of motive power of the same division. In 1874 he was made superintendent of motive power of the Pennsylvania Railroad division, and in 1882 became general superintendent of motive power of the Pennsylvania lines east of Pittsburgh and Erie. From March, 1893, to the date of his retirement he was chief of motive power, Pennsylvania lines east and west of Pittsburgh and Erie.

Theodore N. Ely

Mr. Ely was a member of the American Society of Civil Engineers, the Institution of Civil Engineers (England), the American Society of Mechanical Engineers, the American Institute of Mining Engineers, the Franklin Institute, the American Philosophical Society, the American Association for the Advancement of Science, and other technical and scientific associations. He was a lover and patron of art and had a wide circle of friends in that field. He was vice-president of the American Academy in Rome, and an honorary member of the American Institute of Architects. He was president of the Eastern Railroad Association for several years, and also a member of the executive committee of the American Railway Association and of the permanent commission of the International Railway Congress; also of the boards of trustees of the Drexel Institute of Art, Science, and Industry, and of the Philadelphia Commercial Museum. The honorary degree of Master of Arts was conferred upon Mr. Ely, in 1897, by Yale University, and that of Doctor of Science by Hamilton College in 1904.

The great work of Mr. Ely's life was performed in the mechanical department of the Pennsylvania Railroad, at the Altoona (Pa.) shops, where he inaugurated the department for testing materials, and established the system of purchasing supplies on rigid specifications. This was a new field at that time in railroad work and Mr. Ely encountered much opposition, but he acted on the courage of his convictions, and lived to see the system of specifications, which he inaugurated, adopted by many other railroads. As a result of his work at Altoona, the plan of purchasing railroad supplies on specifications has now become general, to the benefit of both buyer and seller.

SUPPLY TRADE NOTES

The Northwest Steel Company, Portland, Ore., has under consideration the erection of a new $1,000,000 rolling mill, with a capacity of 20,000 tons of steel per month.

Frank L. Severance has been appointed general manager of the Irving-Pitt Manufacturing Company, Kansas City, and H. R. McCleary has been appointed general sales manager.

R. H. Wood, for a number of years connected with the Buffalo office of the Warner & Swasey Company, Cleveland, Ohio, has been appointed manager of the Chicago district office of the Modern Tool Company, Erie, Pa.

Fay E. Possom, formerly connected with the sales department of the Grip Nut Company, Chicago, Ill., has been elected vice-president of the Safety First Manufacturing Company, western representative for several different railway specialties.

Herbert W. Dow, assistant sales engineer of the Nordberg Manufacturing Company, Milwaukee, Wis., has been appointed sales manager succeeding Fred W. O'Neil, who resigned to accept an executive position with the Ingersoll-Rand Company, New York.

The Burdett Oxygen Company, Chicago, Ill., will complete the erection of its Pittsburgh, Pa., plant, at Fortieth street and the Allegheny Valley tracks, on December 1. This will make the eleventh plant to be established by this company in the various industrial centers of the country.

Leo C. Steinle has been appointed direct representative in France of the Modern Tool Company, Erie, Pa., with offices at Paris and Lyons. Mr. Steinle is actively connected with the Steinle Turret Machine Company, Madison, Wis., whose interests he is also looking after abroad.

Robert D. Sinclair, first vice-president of Mudge & Co., Chicago, has been appointed vice-president, in charge of the sales, manufacturing and treasury departments. Mr. Sinclair was born at Chicago on April 12, 1878, and entered railway service in the auditing department of the Chicago & Eastern Illinois in 1892. The following year he accepted a position with the operating department of the Columbian Intramural Railway at the Chicago World's Fair. At the close of this exposition he entered the service of the Union National Bank of Chicago, and remained with it until its consolidation with the First National Bank in 1900, when he went with the larger institution. He left the banking business on September 1, 1910, to become secretary and treasurer of Mudge & Co. On June 9, 1912, he was elected second vice-president of this company, later being made first vice-president. On November 1, 1916, he was appointed vice-president in charge of all departments, as noted above.

R. D. Sinclair

Sydney Dillon has been appointed chief mechanical engineer of the Carnegie Steel Company, succeeding John Hulst, who was recently appointed assistant to the vice-president and chief engineer of the United States Steel Corporation. Mr. Dillon has been with the Carnegie Steel Company since 1889.

The Lagonda Manufacturing Company, Springfield, Ohio, announces the opening of a new branch office in the McCormick building, Chicago. J. E. Chubb, formerly with the Griscom-Russell Company, is in charge as district sales manager. The company's business in this territory was formerly in charge of the Chicago Engineer Supply Company.

William Cooper Cuntz, general manager and director of the Goldschmidt Thermit Company, New York, died on November 2, at Auburndale, Mass., where he was on a visit for the benefit of his health which was impaired by an operation for appendicitis a year ago. Mr. Cuntz was born in Hoboken, N J., in 1871. He attended the Hoboken Academy and Stevens Institute of Technology, graduating in 1892 with the degree of mechanical engineer. He then became connected with the Pennsylvania Steel Company of Steelton, Pa., first with the bridge and construction department and later with the sales department, which he represented in Boston, Philadelphia, London, England, and in Steelton. He was at one time assistant sales manager at Philadelphia and later sales agent with headquarters at Steelton. In 1910 he was appointed by President Taft a delegate to the International Railway Congress at Berne, Switzerland. In the same year he severed his connections with the Pennsylvania Steel Company to become a director and general manager of the Goldschmidt Thermit Company, New York. At the time of his death he was also a director of the Goldschmidt Detinning Company.

W. C. Cuntz

Announcement has been made by the Westinghouse Electric & Manufacturing Company of an extension of its present bonus system to include salaried and office employees on hourly rates, by which they will receive a bonus of 8 per cent of their salary each month providing their total excusable time absent and late during the month does not exceed six hours incurred on not over three occasions.

W. F. Caspers, western sales representative for the Monarch Steel Castings Company, of Detroit, Mich., has been appointed sales representative for the Aurora Foundries Company and the Fox River Iron Company, manufacturers of brake shoes, babbitt metals, journal bearings and railway castings. Mr. Caspers will have haedquarters at 707-708 Transportation building, Chicago, Ill.

Charles Lounsbury has recently been made president and general manager of the American Railway Supply Company, 134 Charles street, New York. Mr. Lounsbury was born in New York City in 1863 and is a graduate of the College of the City of New York. He began his business career in 1887 with the American Railway Supply Company as junior clerk and has been with that company in various capacities ever since.

The Chicago Car Heating Company, Chicago, has issued the following: "The long continued steam hose coupler patent litigation between Chicago Car Heating Company and

Gold Car Heating & Lighting Company has been ended by a decision rendered on October 3, 1916, by the United States Circuit Court of Appeals at Chicago in favor of Chicago Car Heating Company. As there is no appeal, this decision ends this controversy in favor of Chicago Car Heating Company."

William Barlow Ross, secretary and assistant treasurer of Mudge & Co., manufacturers of railway specialties, Chicago, has also been elected secretary and assistant treasurer of the Safety First Manufacturing Company, selling agents for railway supplies, with the same headquarters. Mr. Ross was born on December 24, 1868, at Belfast, Ireland, and was educated in Manchester, England. He came to America in April, 1889, and entered railway service with the Burlington, Cedar Rapids & Northern, as a trucker and checker at Cedar Rapids, Iowa. He was later transferred to the auditor's office, where he remained in various capacities until December, 1892. He was then appointed timekeeper in the superintendent's office, and later chief clerk. From June 30, 1895, to August 31, 1901, he was utility clerk to the vice-president and general superintendent, being then promoted to car accountant. When the Burlington, Cedar Rapids & Northern was absorbed by the Chicago, Rock Island & Pacific in June, 1902, he was made car agent. The following January he was appointed statistician to the general manager of the system. In September, 1903, he was appointed transportation clerk to the third vice-president, and up to December, 1909, was consecutively transportation clerk to the president, statistician to the president and chief clerk to the standardization committee. On January 1, 1910, he was elected secretary of the board of pensions, and later was made secretary of the pension and personal record bureau. On July 1, 1916, he resigned to become secretary and assistant treasurer of Mudge & Co.

W. B. Ross

J. A. & W. Bird & Co., Boston, Mass., distributors of Ripolin Enamel paint, have arranged to have George Price, manager of the New York office, 120 Broadway, handling the metropolitan district for the past eight years, and who recently completed a trip through the south, engineer and handle the sales department covering the entire territory south of New York, as far west as the Mississippi, and also including Louisiana and Texas.

A group of bankers, including Frank A. Vanderlip, Philip W. Henry, Thatcher M. Brown, and Franklin B. Kirkbride, of New York, and Marcus Wallenberg, of Stockholm, have recently acquired from the American group of stockholders a controlling interest in the shares of the Hess-Bright Manufacturing Company. This group of bankers owns also a substantial interest in the S. K. F. Ball Bearing Company of Hartford, Connecticut. The two companies will be operated quite independently of each other.

Judge Hazel, sitting in the district court for the western district of New York, on October 17 handed down a decision in the case of the Safety Car Heating & Lighting Company vs. U. S. Light & Heat Corporation, in which he held that the latter's car lighting equipment did not infringe the Creveling patent owned by the plaintiff, but was manufactured under the McElroy patents owned by the United States Company. He also dismissed a counter claim declaring that the Safety Type F system of the Safety Company was an infringement of the McElroy patents.

The increased demand for its line of hydraulic equipment has led to the completion of plans for extensive plant and equipment improvements in the factory of The Hydraulic Press Mfg. Co., Mount Gilead, Ohio. To relieve the crowded condition of the machine shop, an addition 100 ft. long by 60 ft. wide will be erected; a 20-ft. extension will be added to the present power plant building and the main stock room will be extended and another story added. The tool room will also be extended and a new structural shop built.

Hugh E. Creer, formerly sales agent for the Union Railway Equipment Company, Chicago, Ill., has been appointed general sales representative of the Camel Company, manufacturers of railway specialties, with headquarters in Chicago. He was born in Hardin, Ray County, Mo., in August, 1874. In 1898, he took employment with the Missouri Pacific at Osawatomie, Kan., and in the following year entered the car department of the St. Louis, Iron Mountain & Southern, where he remained until 1904, consecutively as car repairer, inspector, chief clerk, assistant foreman and foreman of freight car repairs. In August, 1904, he left railway work, but returned in September, 1905, as car foreman of the Pere Marquette at Muskegon, Mich. In January, 1907, he was promoted to general foreman of the car department, and in August, 1910, entered the service of the Missouri Pacific as division foreman in the car department at Atchison, Kan. In March, 1911, he took a position with McCord & Company, of Chicago, as mechanical expert, and in March, 1916, joined the sales forces of the Union Railway Equipment Company.

D. P. Lameroux has been appointed general manager of the Pratt & Letchworth Company, Ltd., Brantford, Ont. Mr. Lameroux was born in Mayville, Wis., December 12, 1873. He received his education at the University of Wisconsin, where he took a course in civil engineering as a member in the class of 1895. After leaving college he spent two years in the maintenance department of the Milwaukee Northern Railway, and the California Oregon Railway, and for the following three years was private secretary to the commissioner of the general land office at Washington, D. C. In 1900, he became associated with the Beaver Dam Malleable Iron Company and worked his way up through that organization until, in 1913, when he left to take up another position, he was the company's general manager. During this period, also, he was on the executive legislative committee of the Wisconsin Manufacturers' Association, and for three years of this time was also regent of the University of Wisconsin. In 1913 he entered the railway supply business in Chicago, and was connected with the Cleveland Steel Company and the Trumbull Steel Company. In his new position he will act as general manager of the various malleable plants of the Canadian Car & Foundry, Limited, including the Pratt & Letchworth Company's plant at Brantford and the Malleable iron plant at Amherst.

D. P. Lameroux

Frederick W. Bright, superintendent of motive power, Armour & Company, died at his home in Chicago, Ill., Sunday, October 29. He was born in Barry, Ill., where he received his early education. On attaining young manhood he entered the service of Armour & Company in the mechanical department as an apprentice, being sent to the Kansas City plant, where he remained for 26 years, and during which time he was promoted in turn to every position in this department. At the time of his death Mr. Bright was in charge of all the mechanical and engineering work of Armour & Company.

J. Sterling Goddard, for the past 10 years chief engineer for the American Steel Foundries, Chicago, died at his home in Riverside, Ill., on November 23, at the age of 44. He was born on August 15, 1872, at Monroe, Mich. He graduated from the mechanical engineering department of Cornell University in 1894, and took employment at once with the Western Tube Company, Kewanee, Ill., as an assistant mechanical engineer. He held this position until April, 1898, when he entered the engineering department of the Frazer & Chalmers Company. In 1900 he was appointed chief draftsman in the motive power department of the Chicago, Burlington & Quincy at Chicago, and retained this position until 1906, when he was appointed chief engineer of the American Steel Foundries.

J. S. Goddard

Edward Thomas Hendee, secretary of Joseph T. Ryerson & Son, Chicago, died suddenly at Minneapolis, Minn., on November 12. He was born at Claremont, N. H., on February 22, 1880, and graduated from New York University in 1900. From 1901 to 1902 he was assistant professor of mechanical engineering at New York University. On the latter date he became associated with Joseph T. Ryerson & Son, Chicago, as advertising manager and also built up and became manager of the machinery department. He was made assistant to the president in January, 1911, and in 1913 he assumed charge of the railway supply department. In the same year he was elected secretary of Joseph T. Ryerson & Son. He was particularly successful in developing the domestic and foreign machinery business and the railway supply business of his company. Mr. Hendee was also vice-president and director of the Lennox Machine Company and director of the American-Glyco Metal Company.

E. T. Hendee

CATALOGUES

Pneumatic Tools.—Bulletin No. 130, recently issued by the Chicago Pneumatic Tool Company, takes up the subject of lubrication of pneumatic tools.

Taps.—Bulletin No. 34, recently issued by the Modern Tool Company, Erie, Pa., is a four-page folder detailing the special features, and containing a description and illustrations of Modern collapsible taps.

Gas Engine.—Bulletin 34-x, recently issued by the Chicago Pneumatic Tool Company, deals with Giant gas engines. The booklet describes in detail the engine and its various parts and is well illustrated.

Adjustable Reamers.—Catalogue G recently issued by the Kelly Reamer Company, Cleveland, Ohio, is entitled Kelly Production Tools and is a catalogue of the reamers, adjustable high speed blades and similar tools made by the company.

Machine Tools.—Catalogue No. 51 recently issued by the Newton Machine Tool Works, Inc., Philadelphia, gives specifications, dimension tables and illustrations of the Newton cold saw cutting-off machines. The booklet also contains a number of illustrations showing machines in actual service and a supplementary section is devoted to various milling, slotting and drilling machines.

Simplex Jacks.—Templeton, Kenly & Co., Ltd., Chicago, has issued a 32-page pamphlet illustrating and describing the simplex jack and its application to various industrial purposes. Of special interest to railway men is the application of these jacks to car repairs, the several designs of track jacks and the Simplex Pole jack, designed for placing, straightening or pulling telephone, telegraph or power line poles.

Pulverized Coal Equipment.—This is the title of catalogue No. 71 recently issued by the Lehigh Car Wheel & Axle Works, Fullerton, Pa. The booklet is 8 in. by 10½ in. in size, and contains 28 pages. It gives descriptions and illustrations of the following units used for the production of pulverized coal: The Fuller-Lehigh pulverizer mill, Lehigh coal crushing rolls; indirect fired rotary dryers; pulverized coal feeders, and Fuller quality sprockets.

Grinding Wheels.—The Star Corundum Wheel Company, Detroit, Mich., has issued a catalogue showing its line of Star griding wheels. The book contains 100 pages and in them it illustrates its various types of grinding wheels, noting for what uses they are intended and giving dimensions, price lists and code words. Much useful information is also given as to speeds, mounting, grains, grades, etc. With the catalogue the company is also sending out a 16-page booklet entitled: Safety Code for the Use and Care of Abrasive Wheels.

Feed Water Treatment.—One of the latest publications of the Dearborn Chemical Company, Chicago, bears the title, "Incrustation, Corrosion, Foaming and Other Effects of Water Used in Steam Making and Methods of Prevention." The booklet first emphasizes that the Dearborn Chemical Company does not supply a "cure-all," and that it is not a "boiler compound house." The book in three chapters takes up respectively the subjects of corrosion, including pitting, grooving and electrolysis; incrustation, including soft and hard scale of varying compositions; and foaming, including priming, bagging, causes of explosion, etc., with a discussion of oil in boilers. One section deals with the Dearborn Chemical Company itself, showing how its experts make analyses, work out formulas and compound the proper remedies. The book is well illustrated, several pictures showing parts of the office and plant.

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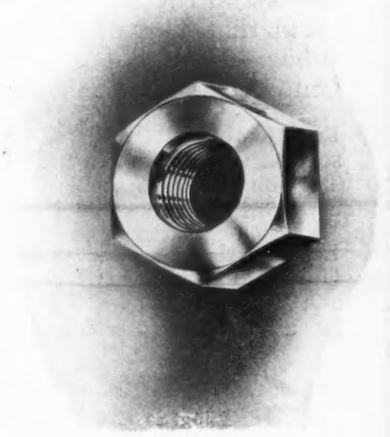

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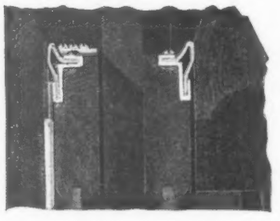

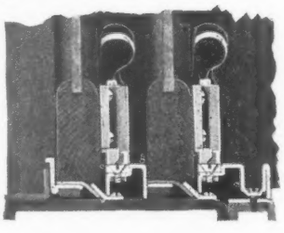

Study the illustration; note just why a sash can't bind; note that the sash actually floats between the brass compression strips and the flexible Universal Weather Stripping. Bear in mind that Universal Weather Stripping is made from pure rubber—it is not a composition—pure rubber backed with genuine canvas, hence its years of resiliency.

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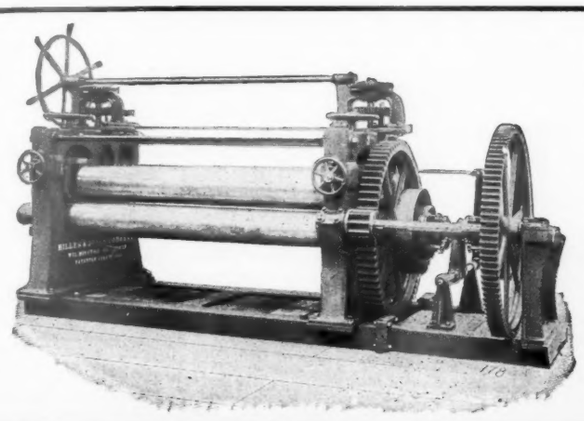

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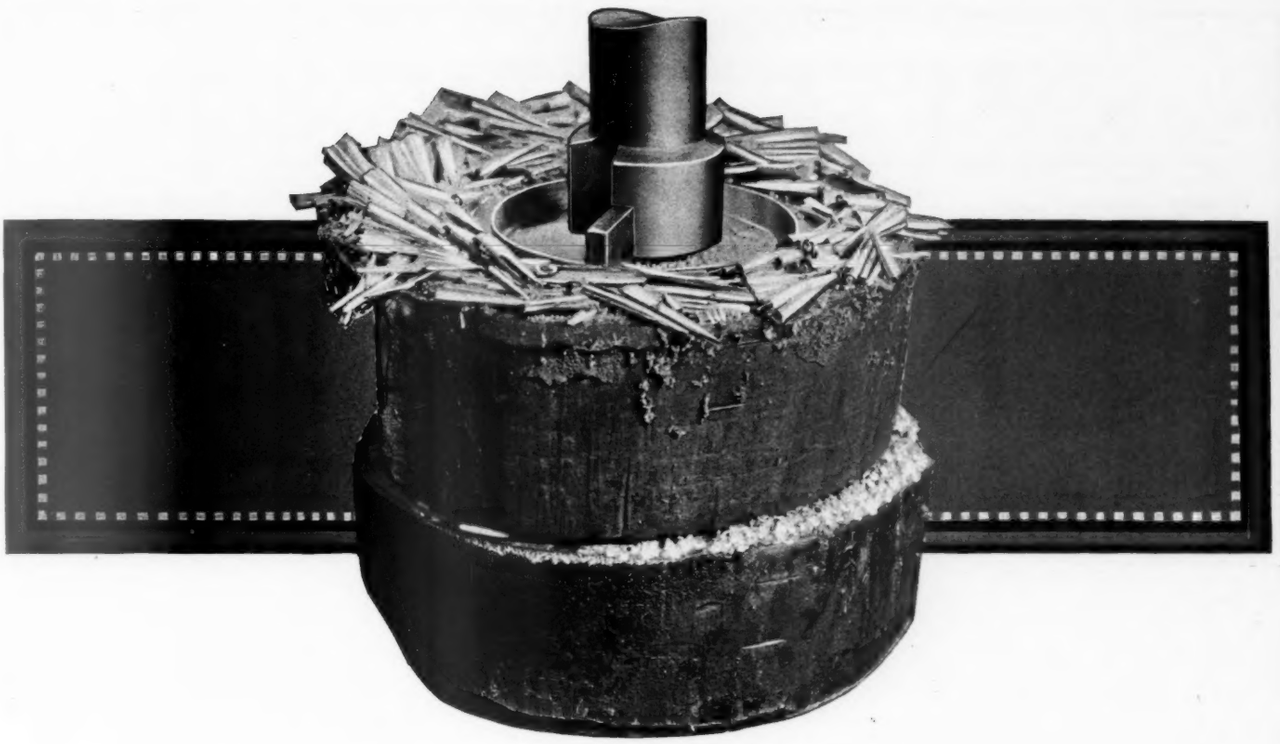

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Simply another proof of the **Power** and **Rigidity** that are the most prominent features of the American Radials.

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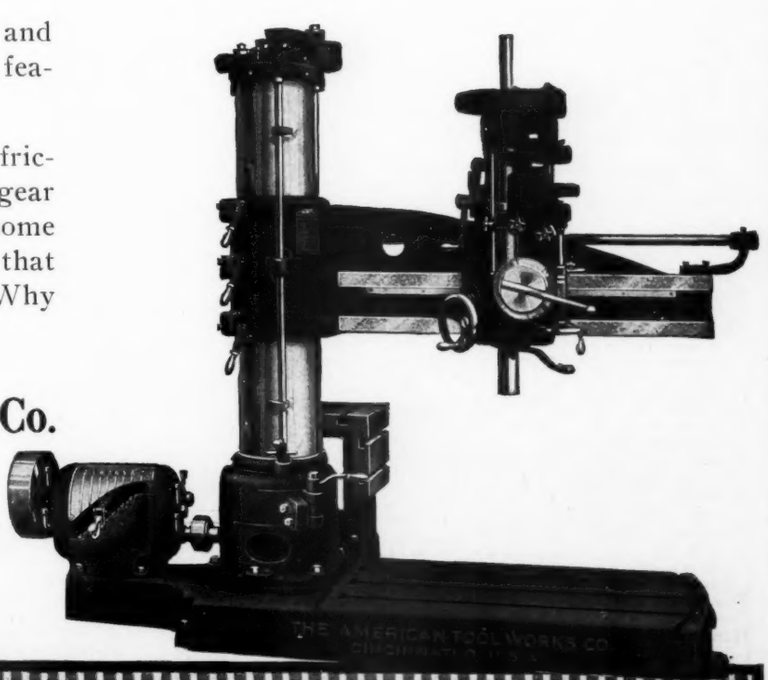

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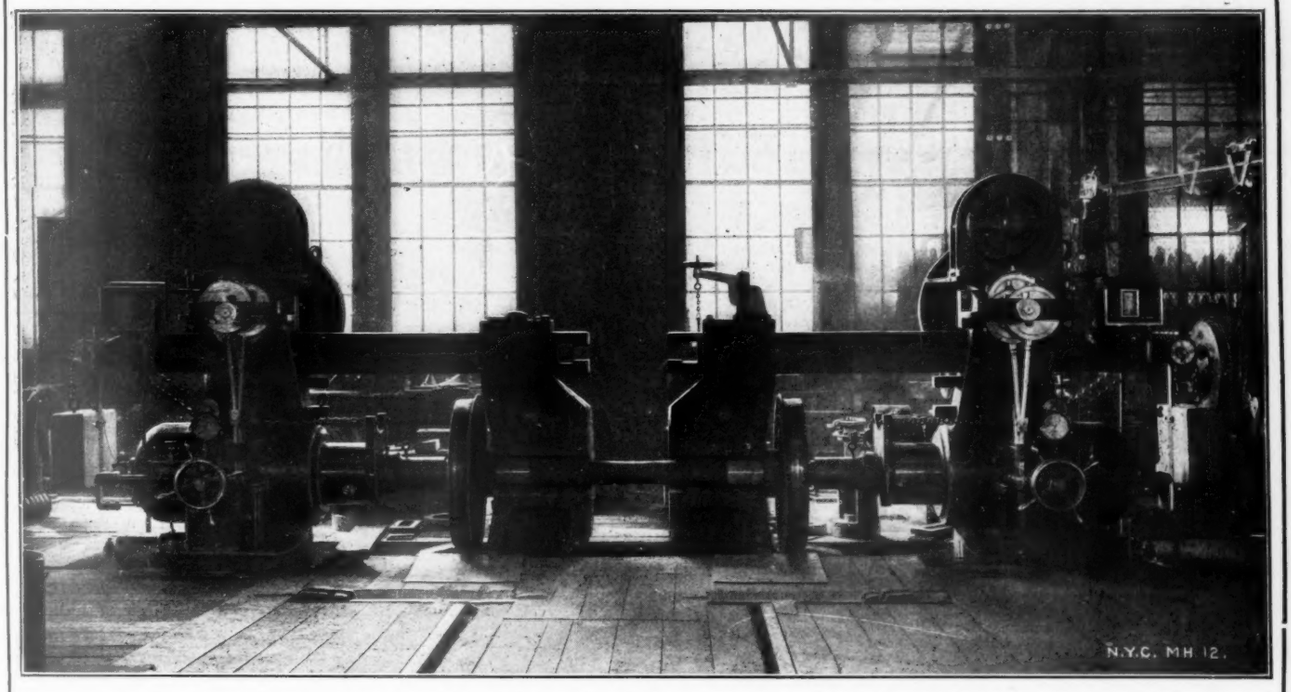
Pressed Off or On



Showing machine in operation at the Mott Haven shops of the New York Central Railroad; Pressing off Wheels.

Double Hydraulic Car-Wheel Press

For Shops Handling Large Numbers of Wheels. Has pressed off 30 pairs per hour.

Pressing Off

Coupling blocks are removed from upper and lower tie bars, a small crane, as shown in illustration, being provided for handling upper coupling block. Wheels are rolled into machine and a forcing block placed over each ram. Pressure is then applied to main cylinders. As soon as rams are in contact with ends of axle, the pressure starts each cylinder backward on base plate, pulling tie bars and resistance posts away from center of machine, thus drawing both the wheels off their axles simultaneously. To bring the cylinders, tie bars and resistance posts back to their initial positions, an auxiliary cylinder is located under each main cylinder.

Pressing On

When pressing on a pair of wheels, the coupling blocks are put in place, securely locking the tie bars together. The axle is held on an assembling jack or by a crane while the wheels are run over the journals. A shoe is placed on the face of each ram for forcing on the wheels. The axles and wheels are then rolled into the machine, the pumps started and the wheels forced upon their fits simultaneously.

Write for Progress Reporters No. 25 and 27.

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Pratt & Whitney Co.
Ryerson & Son, Jos. T.
Sellers & Co., Inc., Wm.

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Shapers, Vertical.
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Macleod Co., The.

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National Tube Co.

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Newton Machine Tool Works.
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Landis Machine Co., Inc.

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American Flexible Bolt Co.
Breakless Staybolt Co.
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Oster Mfg. Co.
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Norris, James L.

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McConway & Torley Co.

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Economy Devices Corp.

Trucks, Electric.
American Locomotive Co.
Baldwin Locomotive Works, The

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Economy Devices Corp.

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Economy Devices Corp.

Trucks, Trailer.
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National Tube Co.
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International Oxygen Co.

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Valves, Muffler Safety.
Ashton Valve Co.
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Valves, Open Safety.
Ashton Valve Co.
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Ventilators.
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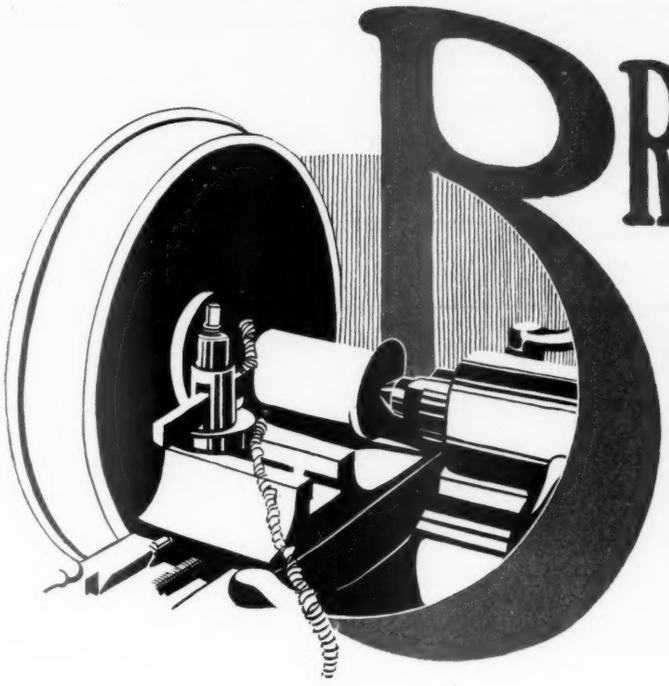
Armstrong Bros. Tool Co.



BRIDGEFORD JOURNAL TRUING LATHE

A Journal Every 10 Minutes

This is possible with the "BRIDGEFORD" because the axle complete with the wheels is chucked in the lathe.

The average production in railway shops using Bridgeford Lathes for retruing journals ready for the trucks, is 54 per day of nine hours, or an average of one journal every ten minutes. In some shops, however, it is not an uncommon occurrence to finish as high as 60 journals in nine hours.

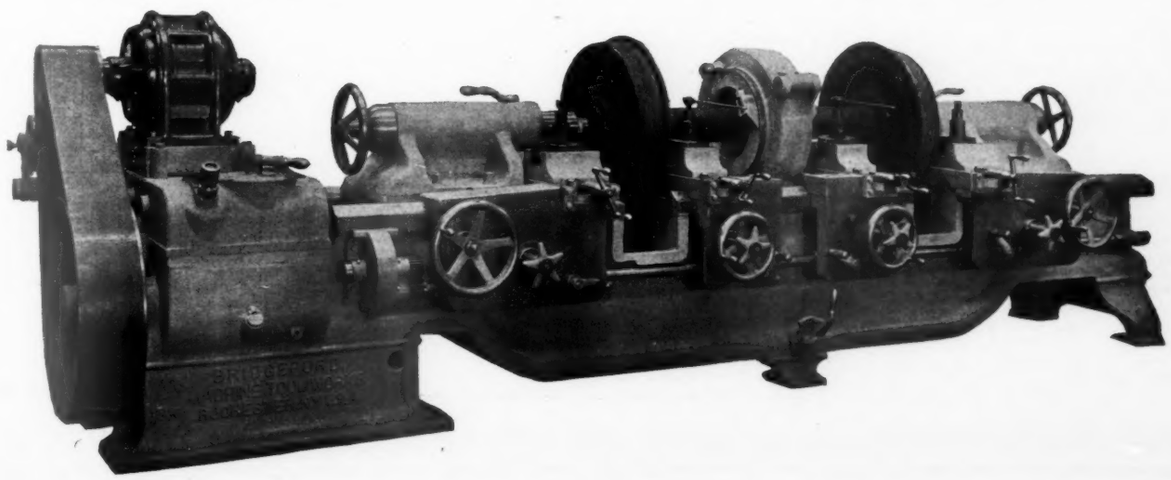
Besides, one operator and a hoist is all that is required for the job—the time-consuming operations of stripping the axle and remounting the wheels, with the attendant labor expense, is absolutely eliminated.

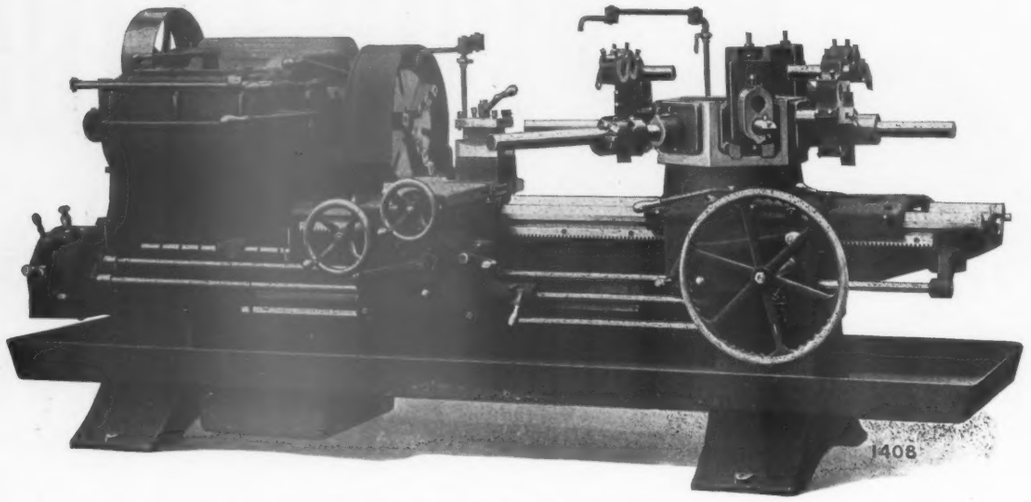
If your output does not compare favorably with the above, write for our Bulletin No. 231 which tells why the Bridgeford Center Drive Journal Truing Lathe will effect wonderful economies in your shop.

BRIDGEFORD MACHINE TOOL WORKS

231 Mill Street, Rochester, N. Y.

Heavy Engine Lathes ***Heavy Axle Lathes***





No. 3-A Universal Hollow-Hexagon Turret Lathe with Chucking Equipment

It "Eats Up" the Work

In one railroad shop that handles the general repair work for an average of ten locomotives each month, all the turret lathe work is produced by one

Universal Hollow-Hexagon Turret Lathe

There are two reasons why this machine is especially valuable in the production of locomotive and car parts and railroad shop tools:

First, its great power, rigidity and accuracy:

Second, the quickness and ease with which it can be tooled and operated for the economical production of duplicate parts —even in small quantities.

Ask for Descriptive Literature.

THE WARNER & SWASEY COMPANY

CLEVELAND, OHIO

New York Office: Singer Building
Boston Office: Oliver Building
Buffalo Office: Iroquois Building
Detroit Office: Ford Building
Chicago Office and Showrooms: 618-622 Washington Boulevard

BLUE CHIP
High Speed Steel

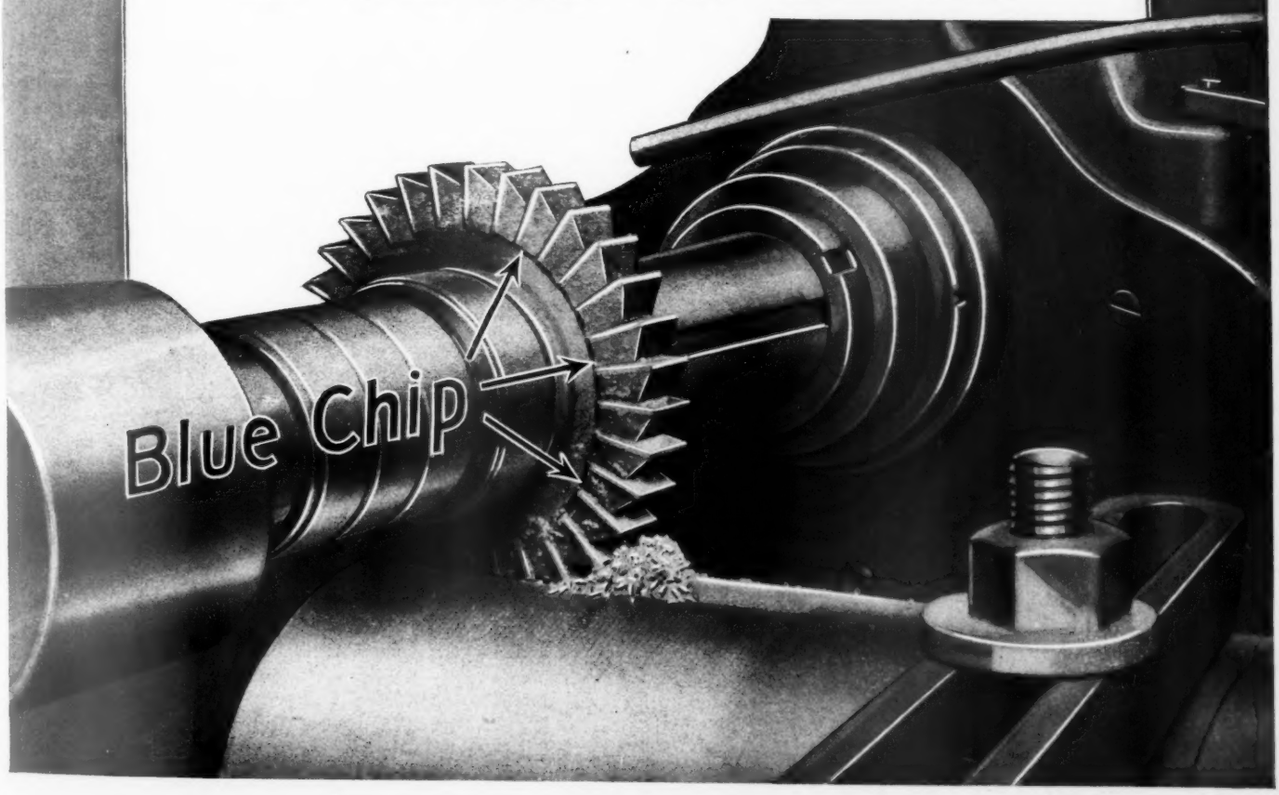
THE illustration below shows a milling cutter of BLUE CHIP HIGH SPEED STEEL cutting a keyway in a driving axle. The cutter which is making 42 R.P.M. is 1″ wide and 6″ diam, and the keyway is ½″ x 1″ x 7″. A feed of .01″ per rev., enables the job to be completed in a little better than 17 minutes.

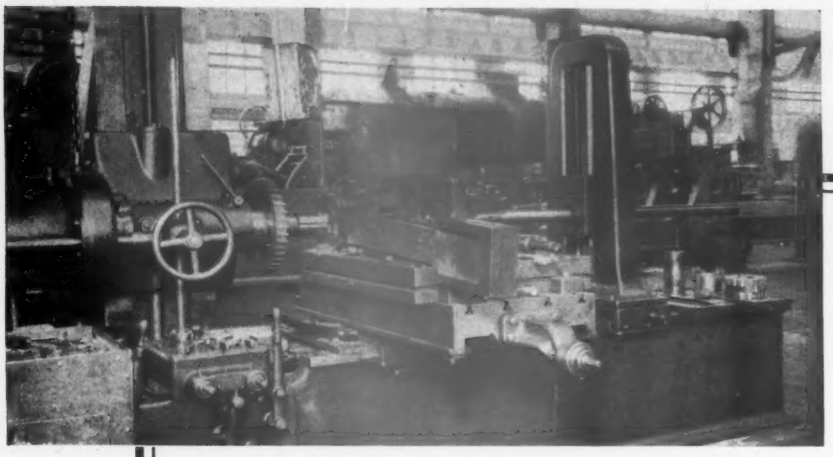
BLUE CHIP has proved an economical investment in the railway shop where this photograph was taken, because it has not only greatly increased production, but also considerably reduced cutting costs.

If you are not getting real cutting efficiency from your tool steel, write us.

Firth-Sterling Steel Company
McKEESPORT, PA.

Boston New York Philadelphia Chicago Cleveland Pittsburgh





Boring hole for the knuckle pin joint in side rod. The first operation is to drill the hole, the second to "hognose" or bore, the third to taper. The taper is ¼ inch in 5 inches. The total time is considerably less than one hour.

Big Savings

have been effected in railroad shops, especially where there is an abundance of jobs requiring more than one operation by using

The Lucas "Precision"

Boring, Drilling and Milling Machine

The time required for carrying the work from one machine to another is saved entirely and also the wait at each machine and the time for setting up.

When a piece of work requires three operations such as boring, drilling and milling, the three jobs are done on a Lucas usually with one set-up and without the use of jigs.

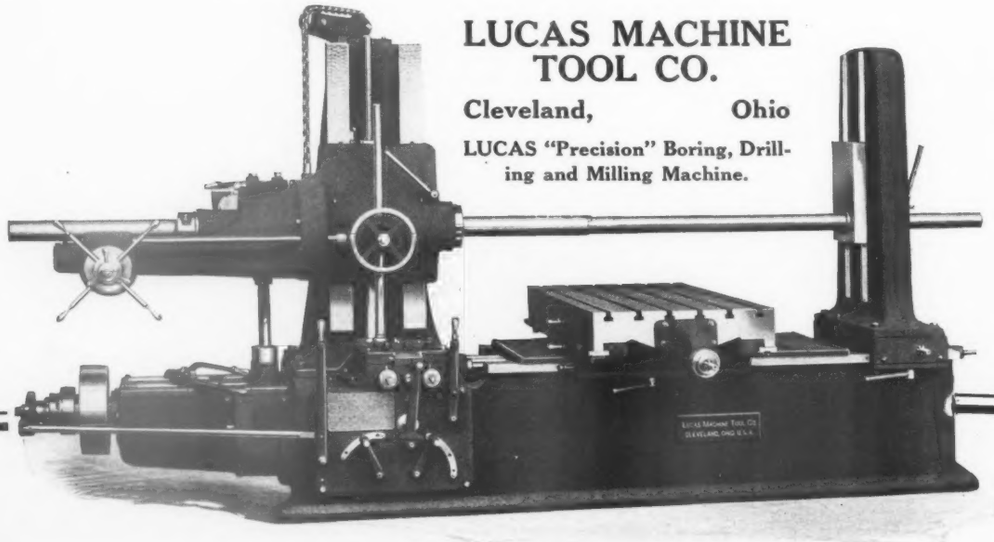
And by the nature of the machine each cut is absolutely square with regard to the others.

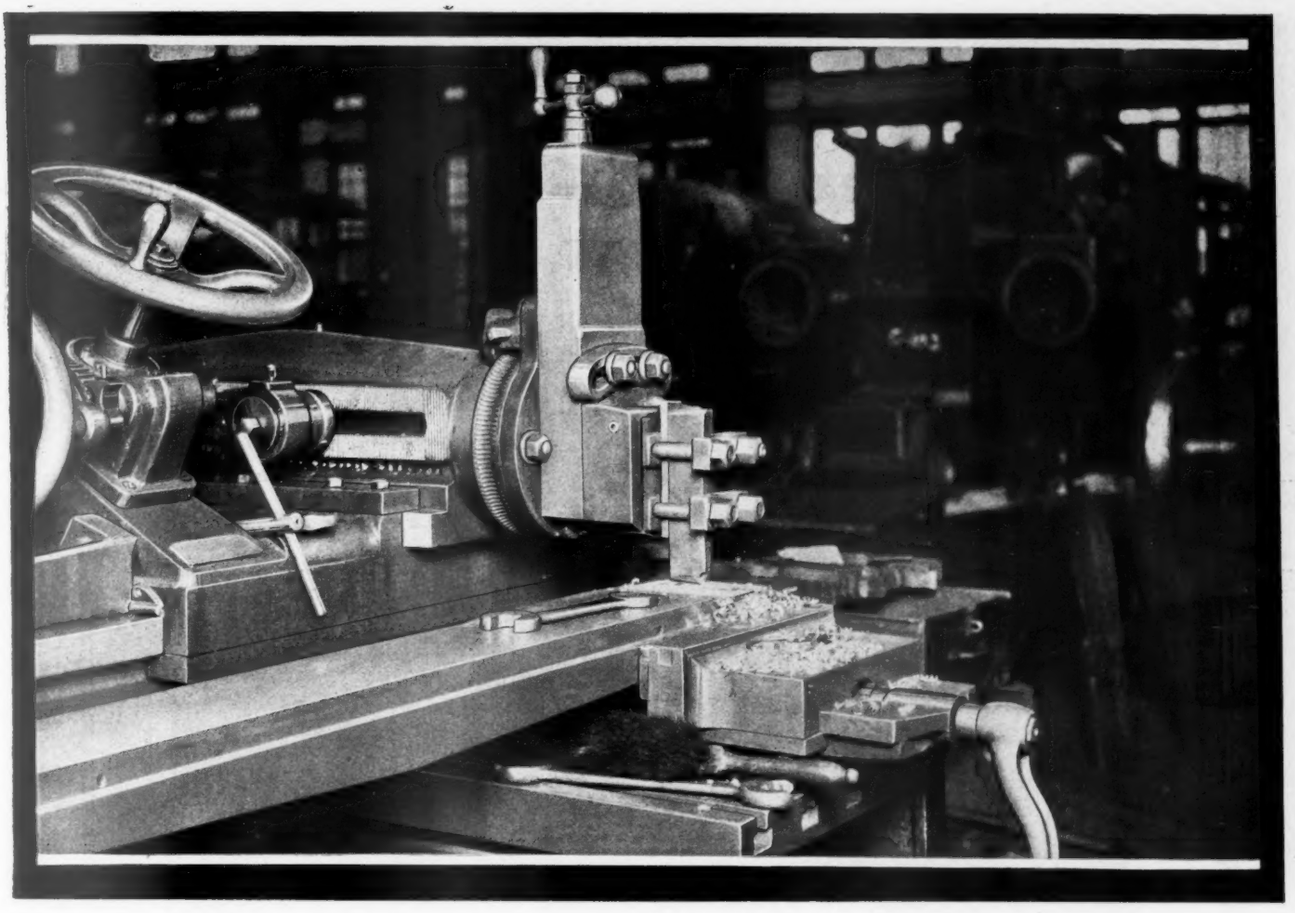
Send for our booklet *"Saving Set-Ups in Railroad Shops,"* a collection of valuable data and photographs obtained in various large railroad shops throughout the country.

LUCAS MACHINE TOOL CO.

Cleveland, Ohio

LUCAS "Precision" Boring, Drilling and Milling Machine.





Distinct Advantage in Railroad Shops

There are many railroad jobs more economically and rapidly done on a Cincinnati Traverse Shaper than in any other way. On small pieces one man can practically double his output by using both tables—setting up on one while the cut is progressing on the other. On large work the two tables are necessary in order to get a perfect set up, and the job is done with one set up instead of two, even though both ends of a long piece are worked on.

In our judgment the ideal shaper for the railroad shop is the

Cincinnati Traverse Shaper

The photograph, taken in an eastern railroad shop, shows a Cincinnati Traverse Shaper shaping the ends of a crosshead guide bar. Both ends are shaped but only one set up is required, and the job is finished in much less time than would be possible on another machine.

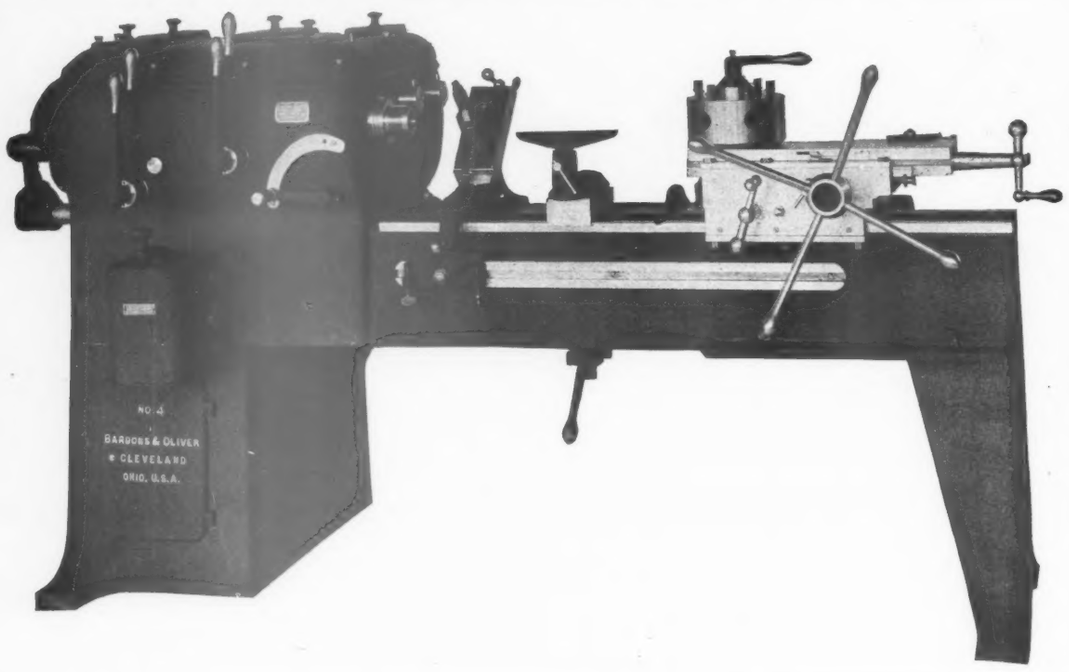
The ability of Cincinnati Shapers to economically and quickly handle so many of the jobs in railroad shops is responsible for the fact that railroads comprising over four-fifths of the total mileage of the United States use them.

Let us send you our complete catalog.

The Cincinnati Shaper Company

CINCINNATI, OHIO

Bardons & Oliver
Motor-Driven "Fox" Lathe



For Short Run Brass Work

This lathe is especially designed to meet the requirements of railroad shops where most of the brass lathe jobs are short runs. Nothing has been omitted that would facilitate the handling of this class of work. A high degree of efficiency is attained. For speed of production and facility of operation this lathe is unsurpassed.

Can be placed anywhere in the shop without regard to line shaft. No belts or countershafts. Clear space overhead for cranes and hoists.

Eight Spindle Speeds. All speed changes and reverse obtained by friction clutches while machine is running. Back gear can be thrown out when running on higher speeds.

Chasing Attachment adjusts on T slot on front of bed. External or internal, right or left, straight or taper threads can be cut with same leaders and followers.

Universal Turret Slide and Saddle has longitudinal and cross motion and can be swivelled to turn and bore taper.

Can be equipped with Automatic Chuck and Wire Feed, Power Longitudinal Feed to turret slide and other attachments.

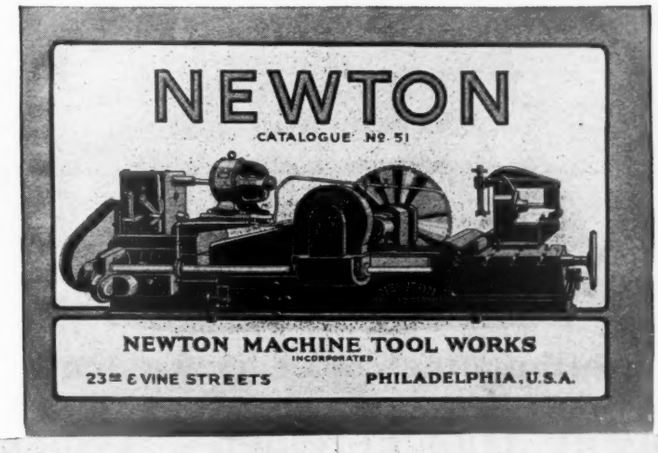
Made in several sizes and with various attachments. Reasonable Delivery.

Specifications and Prices on Request

Bardons & Oliver Cleveland Ohio

Just Off The Press
NEWTON'S ENCYCLOPEDIA
OF
METAL SAWING

Depicts Methods
Apparatus
Production Rates
and Handling
Facilities
for Sawing
Metal Cold



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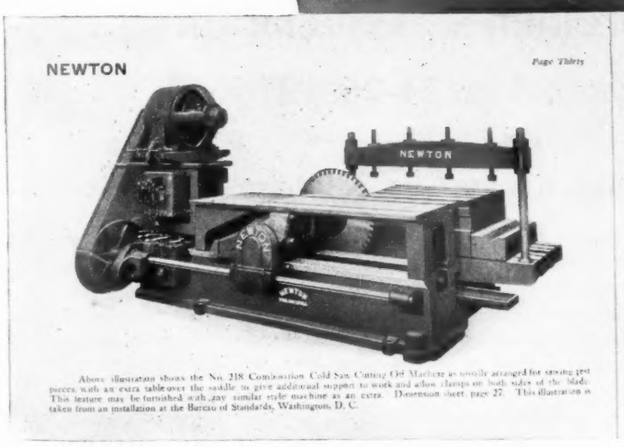
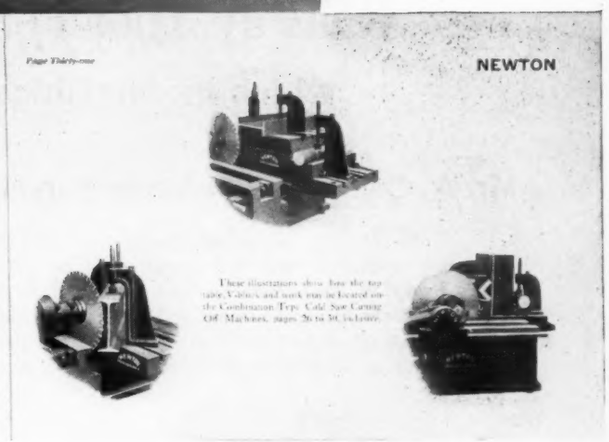

NEWTON
Page Thirty
NEWTON
Above illustration shows the No. 218 Combination Cold Saw Cutting Off Machine as usually arranged for sawing flat pieces with an extra table over the saddle to give additional support to work and allow clamps on both sides of the blade. This feature may be furnished with any similar style machine as an extra. Discussion sheet, page 27. This illustration is taken from an installation at the Bureau of Standards, Washington, D. C.


Page Thirty-one
NEWTON
These illustrations show how the top frame, Vertical and work may be located on the Combination Type Cold Saw Cutting Off Machines, pages 26 to 30, inclusive.

A Careful Examination Will Undoubtedly Be Found Profitable to

Steel and Bronze Founders, Forgers, Steel Ship and Locomotive Builders, Structural Fabricators, Machinists, Electrical Apparatus and Armor Plate Manufacturers.

Sawing machines by Newton are in reality High Duty Milling Machines, and are built with the same precision and rigidity.

We will send you a copy for the favor of your name and address.

Inquiries for Exports Solicited Direct or Through Your Own Broker

Newton Machine Tool Works, Incorporated

23rd and Vine Streets **PHILADELPHIA, U. S. A.**

A "Roundhouse Job"
Usually Means
A Half-done Job

From the Proceedings of the

Railway Tool Foremen's Association

which met in Chicago, Aug. 24-26, 1916

Mr. A. Connell, Tool Room Foreman, Kansas City Southern, Speaking—

"Until recently the use of special tools and jigs for doing the various kinds of work in the roundhouse was unknown, with the exception of an occasional tool made by individual workmen. The back shop received all the attention, the workmen there having many useful special tools. Because of this condition, the term ***'roundhouse job'*** *was commonly used to indicate work that was* ***half done*** *or done just well enough to last one trip of the engine, and it was customary for men in the roundhouse to spend several times as long in doing their work without special tools as would have been required with them."*

From the *Railway Mechanical Engineer*, October 1916.
Excerpts from an Editorial—

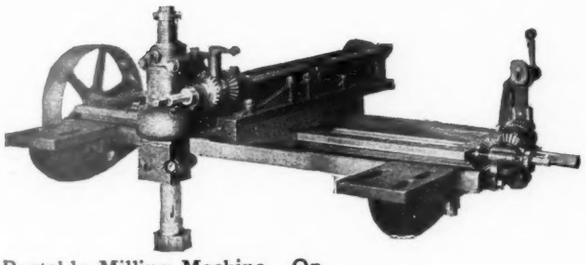
"If there is one place in a railroad organization that needs all the assistance in the matter of good tools and special devices with which labor and repairs to locomotives may be expedited, it is in the engine house."

"It is the duty of the engine house foremen to provide this power many times on sudden demand and to have it in such shape that it can handle its proper tonnage. Quick repairs are often necessary and the necessary means for making them should be provided."

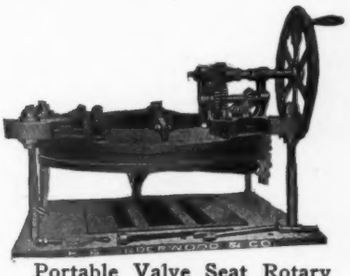
H. B. UNDERWOOD & CO.

UNDERWOOD Portable Tools

Make "Roundhouse Jobs" Well-done Jobs



Portable Milling Machine. Operated either by hand or motor.



Portable Valve Seat Rotary Planing Machine. Operated either by hand or motor.

Our Designing Engineers Will Help Solve Your Problems For Special Tools for Special Jobs

In all roundhouses the very nature of the work requires that the foremen devise tools which will expedite the making of repairs; new problems are constantly presenting themselves, which puts to the test the ingenuity of those in charge of keeping the power away from the back shop and, at the same time, in condition to handle its rated tonnage.

We well realize that those on the job are in a far better position than ourselves to know just what is required in the way of special tools; but they usually have neither the time nor the facilities which are necessary for the realizaton of their plans.

It is at this stage in the development of your ideas that our designing engineers will be able to give you the benefit of their experience, backed by the facilities afforded by the Underwood plant, in solving your problems in connection with the design of tools for the successful accomplishment of their special purpose.

Portable Cylinder or Dome Facing Machine. Operated either by hand or motor.

May we forward our catalogue complete with information that every railroad man should have concerning Underwood Portable Tools.

Portable Crank Pin Turning Machine. Operated either by hand or motor.

PHILADELPHIA, PENNA.

"Increase the Output—Reduce the Cost"

Says Master Blacksmith

In a paper read before the Master Blacksmiths' Convention, Geo. Fraser of the Santa Fe System says:

"There is no place about a railroad shop where such a saving can be made, provided the shop has good tool equipment, as in the blacksmith shop. Good shop organization and a first-class supply of good tools of all kinds are necessary to increase the output and reduce the cost in the smithshop. In the Topeka shops we have about 1,500 dies and formers of all kinds."

AJAX

(Trade Mark Registered)

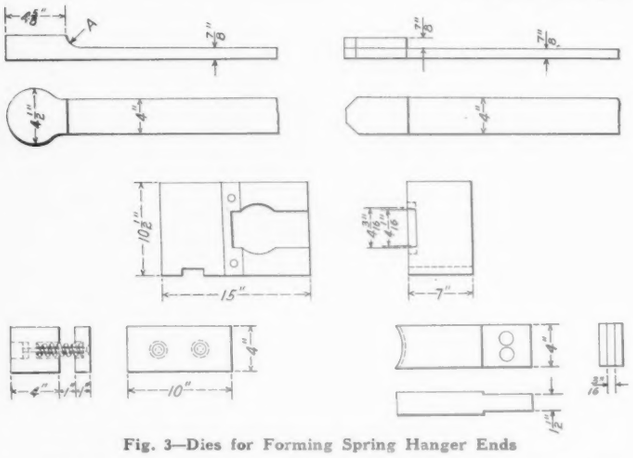


Fig. 3—Dies for Forming Spring Hanger Ends

Fig. 3 shows the dies used for forming the ends of spring hangers on a 4-in. forging machine, and at the same time producing a fillet at *A* without checks, flaws or scarfs. The back stop is set so that the edge *B* on the boss of the hanger is 1 in. from *C* in the dies. The back stop has a spring block, as shown in the illustration, which is forced closed as the header forms the end of the hanger. The header is provided with a groove 3/16 in. wide and ⅛ in. deep to overcome the seam in the center of the boss.

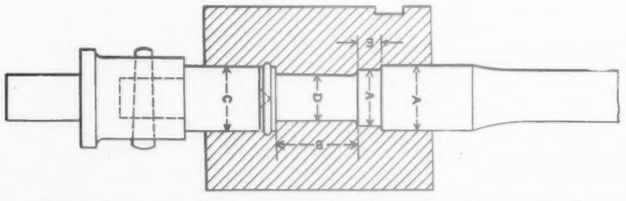


Fig. 4 shows a method of reclaiming car axles. The scrapped 5-in. by 9-in. axles are made over into 4¼-in by 8-in. axles, the 4¼-in. by 8-in into 3¾-in. by 7-in., etc., by the following method: The axle is heated and is made to the correct length at *A*. At the same time the collar on the end of the axle is swedged down to the size of the journal. The axle is then annealed. The ends are heated and forged in a forging machine, the dies for which are shown in Fig. 4. The dimensions *A A* of the dies are ⅛ in. larger than the axle, the dimension *B* is 1 in. shorter than the finished length, *C* is ½ in. larger, *D* is ¼ in. larger, and *E* is ¼ in. shorter than the finished sizes to allow for machining. The plunger upsets the end of the axles and centers them at the same time. Up to the present time over 5,000 axles have been thus reclaimed on the Santa Fe system.

Forging Machines

have been used for many of the money saving jobs in the Santa Fe shops. Two of the jobs are illustrated herewith from drawings shown in Mr. Fraser's paper.

Every one of the 1,500 sets of dies and formers represents some problem solved and money saved by such an equipment.

Ajax Engineers have data on thousands of such railway forge shop jobs. They will be glad to go over this with any railway man.

Write for them to call on you.

The Ajax Mfg. Co.

CLEVELAND, O.

621 Marquette Bldg.
Chicago, Illinois

1369 Hudson Terminal
New York City

The Foote-Burt High-Duty DRILL

(Compound Table)

Built Both 24 and 36″ Swings

Has a capacity for high speed drilling up to 3 inches, in solid steel, feeding to the full capacity of the cutting edge.

All speed and feed changes are accomplished through a new quick change gear device of our own design. The levers for stopping the machine and for changing speeds and feeds are conveniently located and are within easy reach of the operator at all times.

Single Belt Drive

No Shifting Of Belts Required

All Levers Within Easy Reach

THE RIGID DESIGN, the long spindle bearings and the perfect ease with which the operator controls the machine, make the Foote-Burt Drills particularly suited to the classes of work where extreme accuracy is required. The Compound Table is an extra attachment, consisting of an entirely new knee for this purpose, the advantages of which are obvious.

Send for Circulars of High Duty Drills

THE FOOTE-BURT CO., Cleveland, Ohio

David Whitney Bldg., Detroit **Wells Bldg., Milwaukee**

The Tap that Wears Out Before it Breaks

It Shears

GTD

"Gun" Tap

—works in just this way

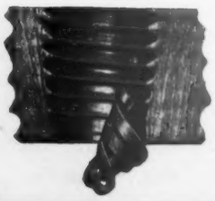
—the chips are sheared out and forced ahead of the tap.

All the cutting is done on the first few teeth—the balance of the threaded section acts as a lead screw.

The deflecting of the chips prevents the chips collecting in the flutes of the tap and does away with binding, cutting over size, and breaking.

The small cut below shows a section of threaded hole tapped with the "Gun" Tap.

Note the angle at which the chips are cut—this explains the deflecting action which throws the chips ahead of the tap.



The G. T. D. "Gun" Tap

PATENTED DECEMBER 28, 1915

A brief summary of some of the qualifications of the "Gun" Tap explains in part the sudden success and popularity of this remarkable tool.

The "Gun" Tap is made of special tap steel—assuring uniformity in hardness, cutting size and lead.

It cuts true to size in any and all materials.

It shears and cuts instead of scraping, requiring ⅓ to ½ less cutting power.

All the cutting is done on the point—the cleanly cut, accurate threads are not marred by the balance of the threaded section.

Higher cutting speeds are practical—giving greater production.

Method of regrinding insures long life and maintenance of cutting size.

Chips do not accumulate and clog in the flutes.

There is as much metal in the threaded section as in the shank.

These combinations of material, principles of design, strength and ease of cutting, make this tap possible.

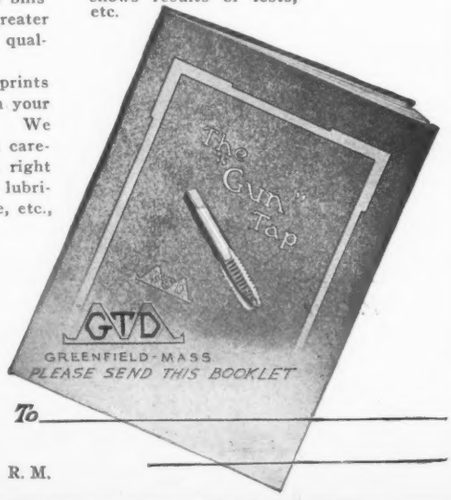
The Tap That Wears Out Before It Breaks

saves 90% of your tap bills besides giving you greater production and higher quality of work.

Send us your blue prints or samples of work on your tapping proposition. We will go over the work carefully and suggest the right tap, cutting speed, lubricant, size of drill hole, etc., for best results.

Clip This Corner Now

and get the new bulletin that goes into detail—shows results of tests, etc.



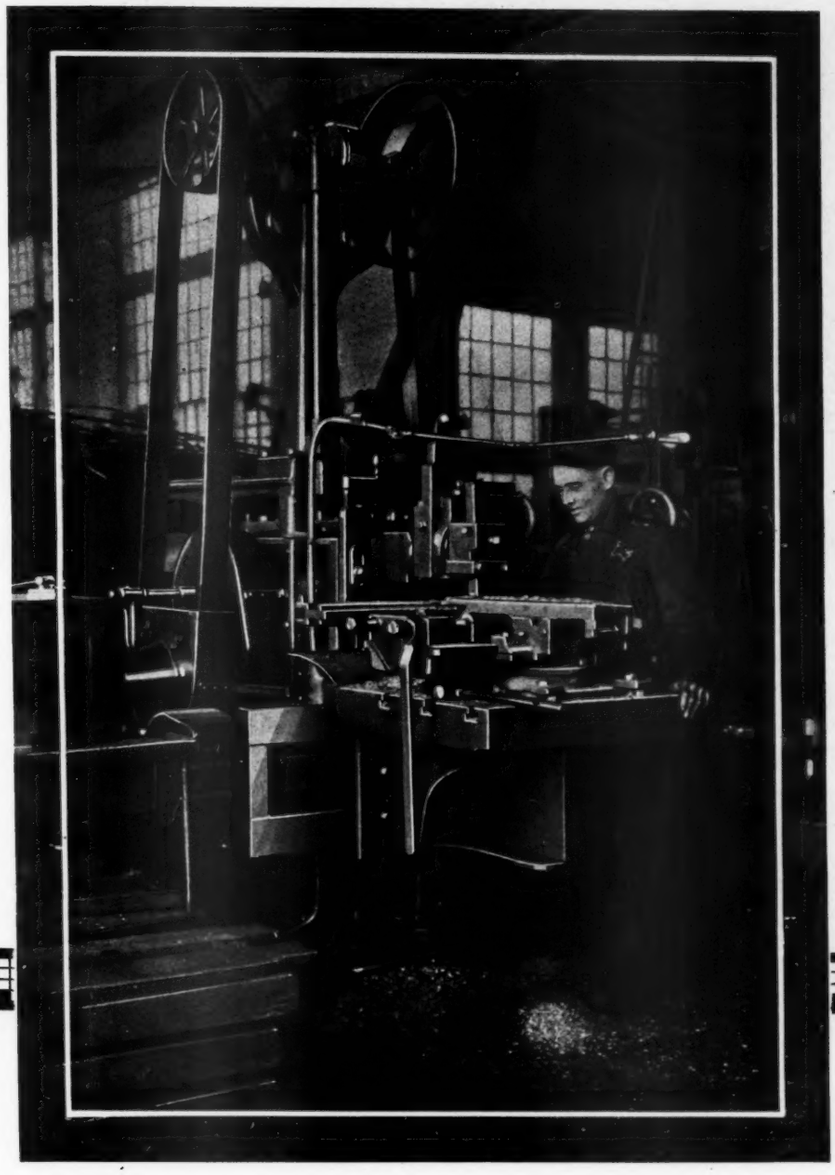
To _____

_____

R. M.

GREENFIELD TAP AND DIE CORPORATION
GREENFIELD, MASS.

New York.....28 Warren St.
Chicago.....13 South Clinton St.
Canada: Wells Brothers Company of Canada, Limited, Galt, Ontario



A Most Important Factor

in the efficient operation of railroad shops is the **time element.** Machine tools must be heavy, powerful and mathematically accurate, but above all they must be able to turn out good work at a good rate of speed. The fact that these requirements are adequately met is responsible for the popularity of the

Morton Draw Cut Shaper

The illustration shows a Morton planing the face of a driving box shoe. The surface is 23 inches long and 5½ inches wide. Three operations are required—roughing cut, finishing cut and rounding edges and the total time is 18 minutes including set-up.

The Morton Draw Cut Shaper **draws** the work against the back-bearing thereby reducing the strain on the table supports and eliminating chatter by setting up a tensile strain in the ram. This is especially advantageous on long stroke work. Also a constant cutting speed and a constant motor load are maintained regardless of the length of the stroke.

Write for Bulletin R No. 6, containing full description of Morton Draw Cut Shaper.

Morton Manufacturing Co.

Muskegon Heights, Michigan

Production low.
Insurance rates high.

Production greatly increased.
Insurance rates reduced 15 to 20 percent.

Westinghouse Machine Tool Motors Make Working Conditions Safe

"My, what a relief!"

—Ever have that feeling as you sped away from the noisy, crowded city? If so, you can appreciate the mental relaxation coming to the workman who steps from the shop at the left into the one on the right.

It was once a necessity to work in dangerous, improperly lighted shops, surrounded by a confusing network of line shafting and belts. The inability to concentrate—the scattered efforts—the nervous strain of such surroundings, has caused the loss of life and limb.

The workman's loss is your loss—you pay the penalty from day to day—in lack of efficiency—in congested shops—in loss of time and money—and, in decreased production.

Send for Book 3042-A and learn how shop practice may be brought to the highest standard.

Westinghouse Electric & Manufacturing Company

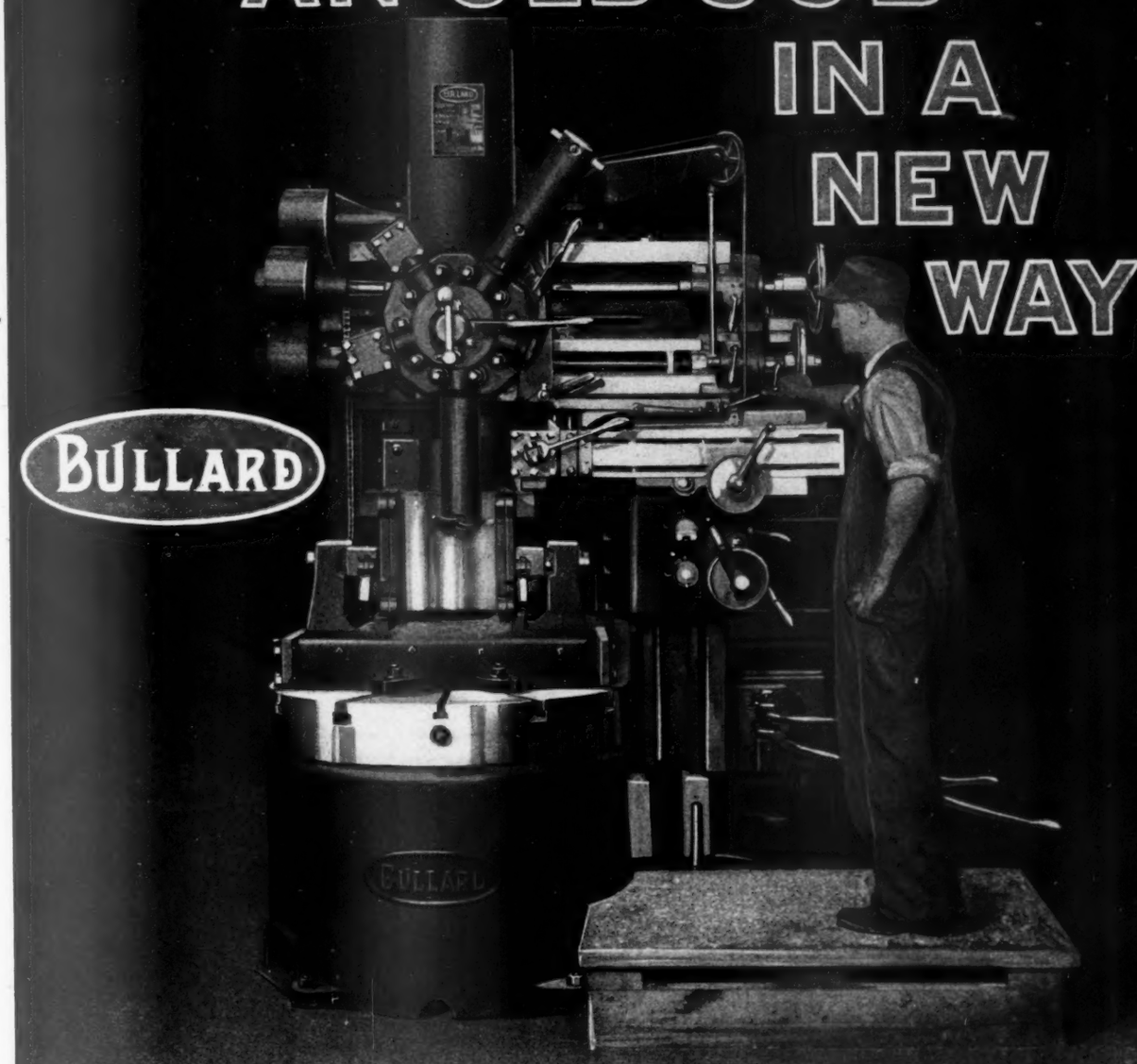
East Pittsburgh, Pa.

Sales Offices in all Large American Cities

W
WESTINGHOUSE ELECTRIC

Westinghouse

AN OLD JOB IN A NEW WAY



A BOX BRASS BORING JOB ON THE BULLARD

10½ in. x 14 in. Brass, Bored and Faced, 20 Minutes

The Main Head bores—rough and finish—and rounds the fillet
The Side Head faces the hub lines
Two Turrets carry the tools required—all set for the job
Micrometer Dials reduce the time required for getting sizes—and
Chrome Nickel Gears and proper design give the strength, the rigidity and the "stay there" to do

AN OLD JOB IN A NEW WAY

Your copy of "CUTTING TIME BETWEEN CUTS" is ready for mailing
Write for it—NOW

The BULLARD MACHINE TOOL COMPANY, BRIDGEPORT CONN., U. S. A.

For General Work

It makes no difference whether the job is bar work or chucking work—multiple or short-run production, maximum efficiency is assured if the work is done on a

Cincinnati Acme Flat Turret Lathe

The illustration shows a 3¼" x 36" Cincinnati Acme working on Piston Rod Glands for 3½" Piston Rods. The job requires two chuckings, but the time for finishing complete is within 30 minutes.

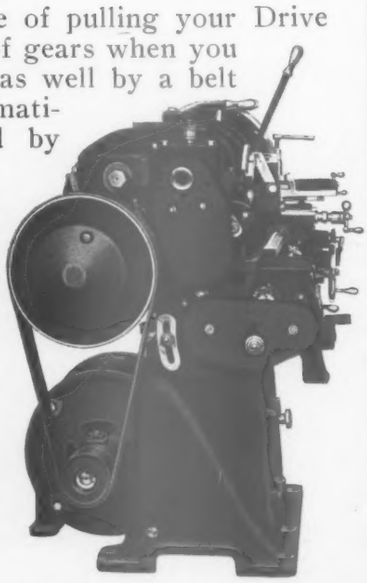
The perfection of design and high quality of material and workmanship in this machine demand your consideration.

Complete information on request.

Acme Machine Tool Co.
Cincinnati . . . . Ohio

Quiet and Efficient

What's the use of pulling your Drive through a lot of gears when you can do it just as well by a belt that is automatically tightened by the weight of the motor? The biggest users of Electric Motor Drives in the country have come to this Drive not only because it is quiet, but because it is efficient. Why not you?



The Greaves-Klusman Tool Co.
Cincinnati, Ohio, U. S. A.

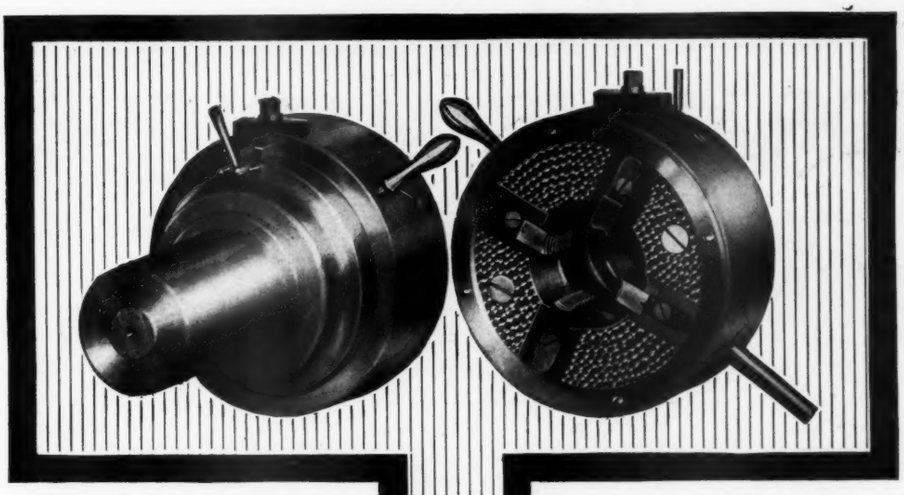
Two Cutting Speeds

and constant return are the features of our **Patent Tu-Speed Drive.** The change from one speed to another is accomplished instantly while the machine is running.

We originated this device to meet the demand for a more than one speed planer and the results have been highly satisfactory.

Full information upon request.

CINCINNATI PLANER CO.
CINCINNATI, OHIO



Modern Self-Opening Die Heads

In use on a Warner and Swasey Turret Lathe in a large railroad shop.

Modern Self-Opening Die Heads are adaptable to all kinds of threading work. They are used on all styles of turret lathes, staybolt threading machines, etc., and always prove highly satisfactory.

The Gen. Foreman says: "We like the Modern Die Head because of its large bearing surface under the dies. This means strength and accuracy and extra long life."

Modern Die Head will last fully as long as the machine itself.

Machine Tool Manufacturers will furnish any equipment specified. Why not get the Die Head of quality—The Modern. Specify Modern Die Heads on new machines.

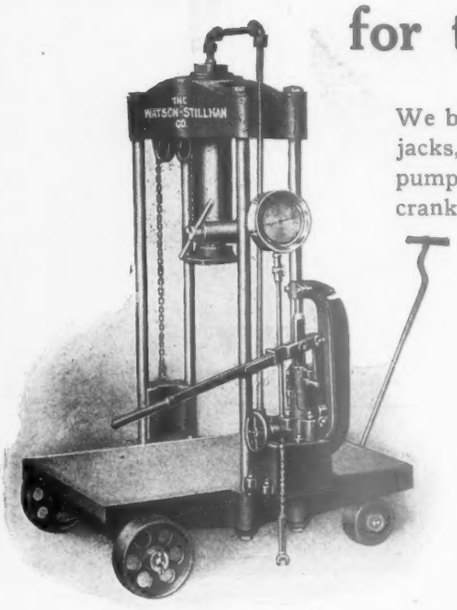
MODERN TOOL COMPANY

Main Office and Works **Erie, Penna.**

NEW YORK OFFICE: 2 Rector Street
DETROIT OFFICE: 246 Gladstone Ave.
CHICAGO OFFICE: 32 N. Clinton Street
F. Wesley Parker, Resident Eng'r and Export Agent, 2 Rector St., New York

HYDRAULIC MACHINERY

for the Railroad Shop

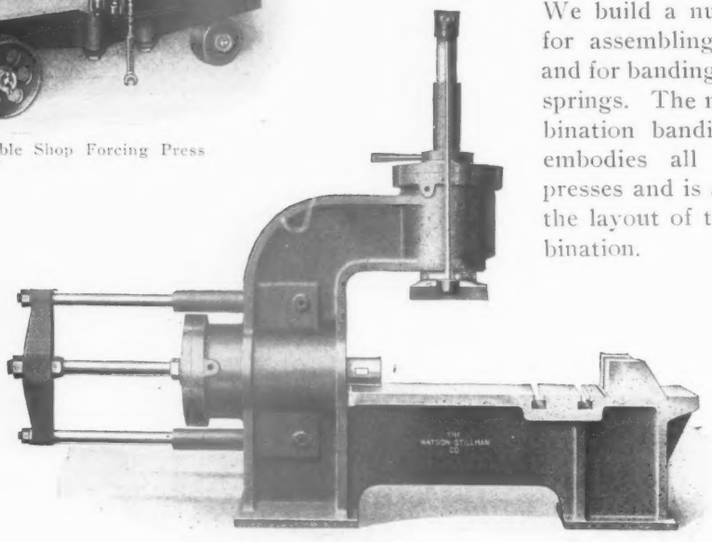


Portable Shop Forcing Press

We build many hydraulic tools for railroad use—benders, bulldozers, jacks, pit jacks, shaft straighteners, rail benders, punches, shears, pumps, accumulators, wheel presses, forging presses, forcing presses, crank pin presses, etc., etc.

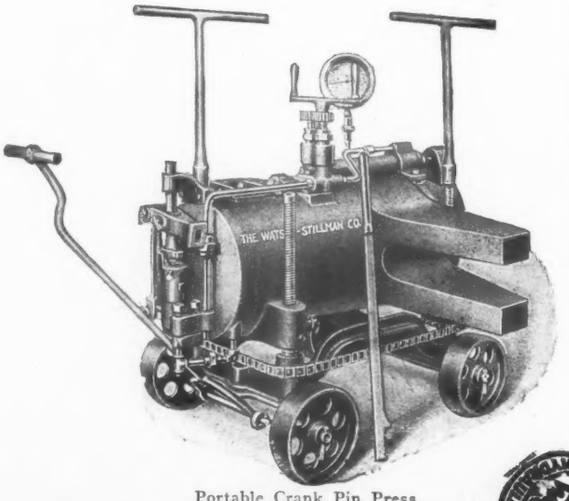
Here is a handy, portable, self-contained hydraulic press for forcing sleeves, bushings, mandrels, broaches, cylinder linings and a variety of miscellaneous bending, straightening and general shop uses. We build them in a number of types, both open jaw, two and four rod styles, single or double plunger pump.

We build a number of hydraulic machines for assembling elliptic springs for testing and for banding and stripping the bands from springs. The machine shown here is a combination banding and stripping press. It embodies all the features of individual presses and is a very economical tool where the layout of the shop permits of this combination.



Combined Spring Banding and Stripping Press

We show here one of our presses for forcing crank pins into locomotive wheels and for miscellaneous shop and field forcing work. These presses are built adjustable in height so that the center line of the ram can be brought in direct line with the center of the pin without moving the wheel. These presses are built in a variety of sizes and with either hand pump or motor driven pump.



Portable Crank Pin Press

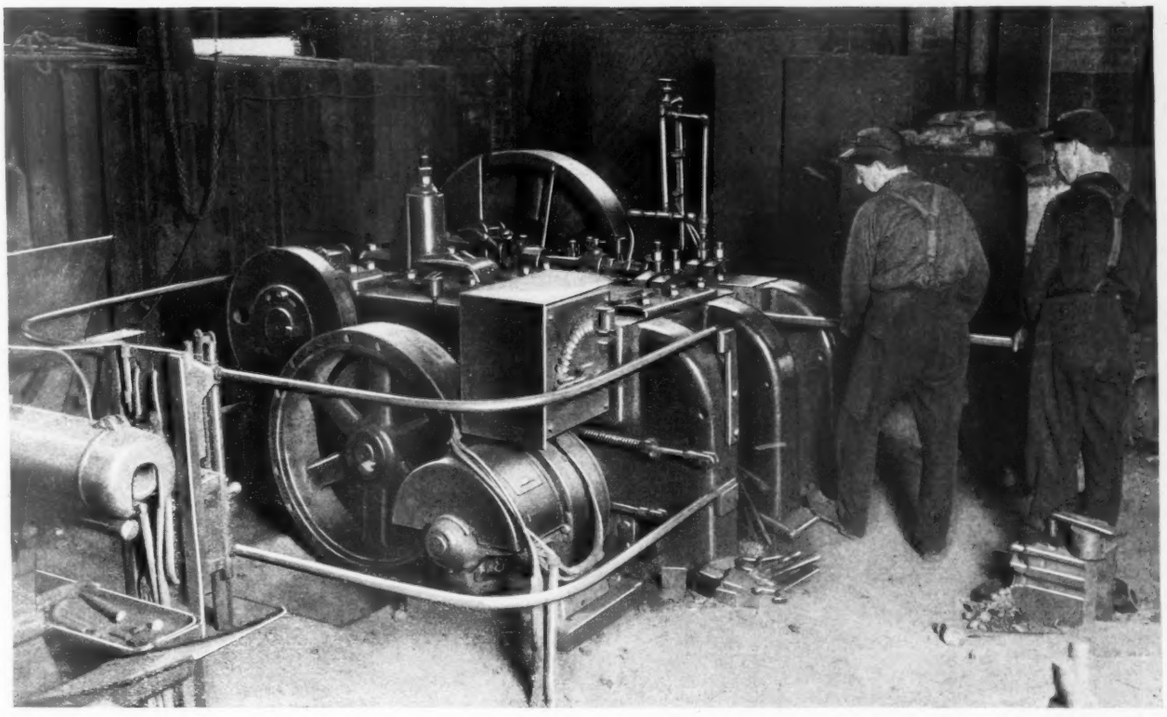
The Watson-Stillman Co.

ENGINEERS AND BUILDERS OF HYDRAULIC MACHINERY

188 Fulton St. New York City

Chicago, McCormick Building 351

The Only Limit to Production is the Capacity of the Furnace



Acme Heading and Forging Machines

Acme Heading and Forging Machine upsetting superheater tubes. There are two operations with two heats. The first operation is upsetting the end, and the second is forming the stock for the ball joint. The production is limited only by the activity of the operator and the capacity of the furnace. The latter is most important and should be constructed according to the most approved design.

The dies and plungers are constructed to turn out a finished product with a minimum number of blows. Square and Hexagon heads are made with two or three strokes; standard upsets at one stroke; and rivets at a single stroke right off the rod.

We also make a complete line of Hot Pressed Nut Machines, Rotary Thread Rolling Machines, Hammer Bolt Headers, Nut Burring Machines, Automatic Feed Bolt and Rivet Heading Machines, Automatic Nut Tappers, and Automatic Bolt Threaders.

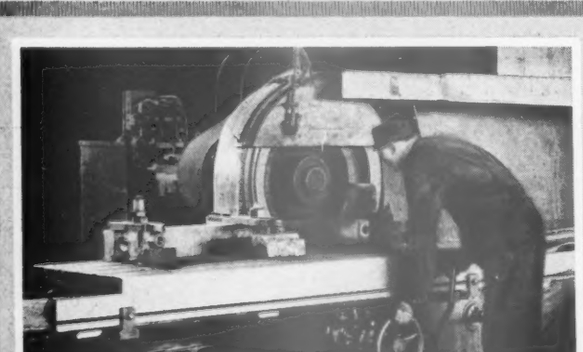
Full information on request.

The Acme Machinery Co. **Cleveland, Ohio**

CARBORUNDUM WHEEL IN THE FOUNDRY

ALOXITE WHEEL FOR TOOL GRINDING

CAR WHEEL GRINDING CARBORUNDUM WHEEL



ALOXITE WHEEL GUIDE BAR GRINDING

The Grinding Wheel in the Railroad Shop

GRINDING has become a recognized shop economy and the grinding wheel an indispensable tool for the quick removal of stock, the production of accurate dimensions, fit, and finish—in the saving of time and labor.

Carborundum and Aloxite Grinding Wheels

Have made possible a hundred and one railroad grinding operations—they have in many cases revolutionized railroad shop practice.

Carborundum for car-wheel grinding, brass or bronze bearings, general cast-iron work.

Aloxite for guide-bar grinding, link grinding, and general steel work.

The real secret of successful grinding is in getting close to Carborundum service in getting

The Right Wheel in the Right Place

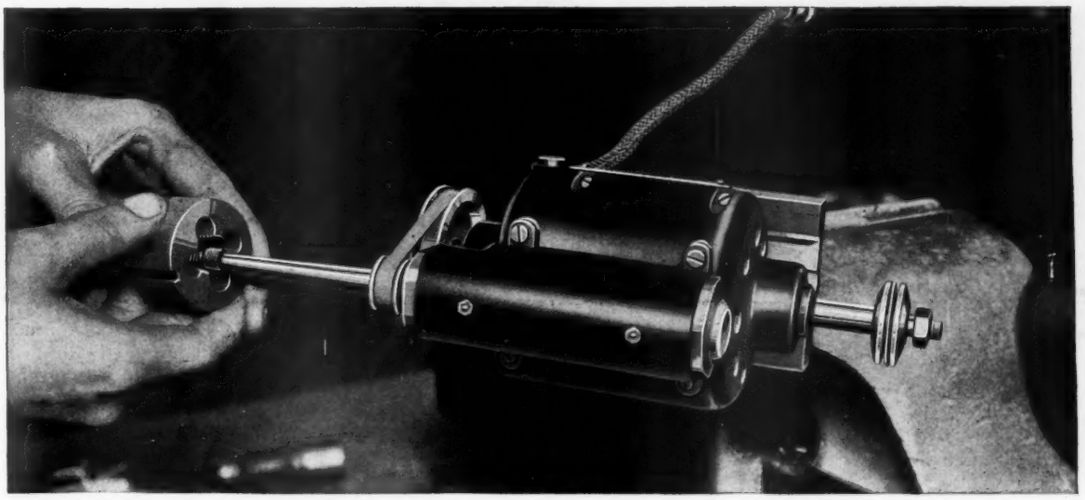
Write Our Service Department

—

The Carborundum Company

Niagara Falls, N. Y.

New York Chicago Boston Philadelphia
Cleveland Pittsburgh Cincinnati Milwaukee



Re-grind Your Threading Dies With the Dumore Grinder

When a bolt threading die becomes dull or battered, the usual practice is to anneal the die, then have your tool-maker file it out and re-harden it. If you follow this operation carefully you will find it takes about three hours on the average. Then the die must be re-hardened, which is very liable to warp it. All of this can be eliminated and the work done in 1/12 of the time by using a DUMORE Grinder. It means that you can grind the hardened die. There will be no necessity of annealing it.

The DUMORE Grinder is doing unusually good work for a large number of manufacturers and Railroads. It will do a great variety of grinding and the more difficult the job, the better the DUMORE shows up.

What you need in order to do an accurate job of grinding is high speed. This you get with the DUMORE; 10,000 r.p.m. on the motor spindle and 30,000 r.p.m. on the internal spindle. The DUMORE is the only portable grinder giving you the correct surface speed.

The motor used in connection with the DUMORE Grinder is one of our universal type, operating equally well on direct or alternating current. The motor and the internal spindle are equipped with S. K. F. Ball Bearings. All moving parts are dynamically balanced, eliminating all vibration. The DUMORE quickly becomes known as the "handy tool" as it can be carried from one job to another and set up in a lathe, shaper or milling machine in a moment.

Let us tell you more about this Grinder. We will be glad to put the Grinder in one of your shops so that you can test it under actual working conditions.

WISCONSIN ELECTRIC COMPANY

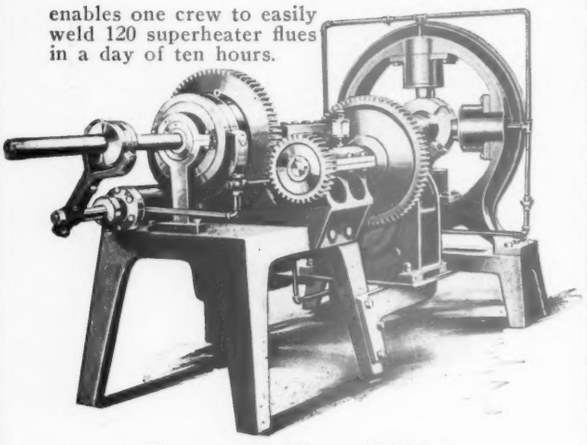
4003 DUMORE BUILDING RACINE, WISCONSIN

Flue Welding Difficulties Eliminated

Built to meet the requirements of present day railroad shops, and in the light of years of experience with flue welding. Embodying many distinctive features which make for better results and greater economy in operation, the new

SOUTHWARK FLUE WELDER

enables one crew to easily weld 120 superheater flues in a day of ten hours.



Three-quarter View of Welder

A special device allows the working of the weld on the *inside* instead of on the outside. Further, it is built sufficiently strong to perform the welding of large flues, and it takes safe ends of length greater than the limit of the ordinary type of welder.

Furnace is located immediately in front of welding mandrel, thus effecting a saving in time and heat. Motor located on the frame work underneath the gearing, takes up little space. Due to economy of operation, the size of this motor is less than for any other flue welder.

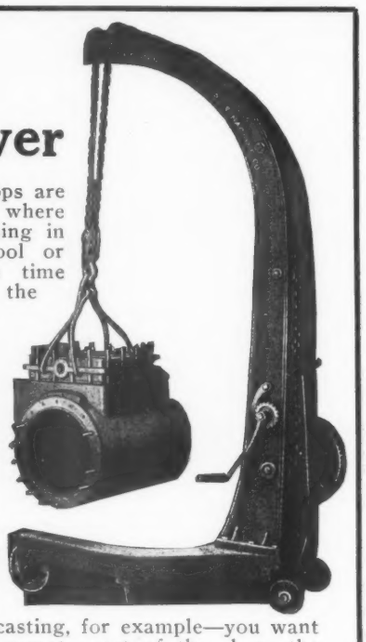
Send for new circular explaining how the Southwark Welder eliminates the flue welding difficulties encountered in the past, and describing its strong features and distinct advantages. It is a step to better results and lower costs. Get the facts concerning this addition to the Southwark line.

Southwark Foundry & Machine Co.

Philadelphia, Pa., U. S. A.

A Time Saver

Where railway shops are working overtime; where rush orders are coming in every day, every tool or machine that saves time pays a dividend on the investment.



Canton Portable Crane

Here's a portable crane that calls for the service of one man — yet the one man and this crane do the work of six men. Take a 2-ton casting, for example—you want to place it in some remote part of the shop—the overhead crane can't reach the place. The Canton Portable Crane with one man can do the job. That's why over 50 railroads are using Canton Portable Cranes and that's why railway shop men call it **"The Handiest Tool In The Shop."**

Book E-53 with details and prices on request.

CANTON FOUNDRY & MACHINE CO.

CANTON Manufacturers of **OHIO**

Industrial Turntables, Portable Floor Cranes and Hoists.

Used in Many Railroad Shops

For Irregular Forgings many Railroads regularly use

ERIE SINGLE FRAME STEEL FORGING HAMMERS

because of the liberal distance between the Die and Frame, and because these hammers are built not alone for such service, but **for hard service.**

Anvil, Frame and Cylinder, semi-steel castings — not ordinary gray iron. Piston and Rod forged from best grade of open hearth steel in one piece. Safety Piston Stop. Absolute control of hammer at all times.

Deliveries Can Be Made Promptly.

Drop Us a Postal for More Information

ERIE FOUNDRY COMPANY

Erie, Pa.

In Step With The Stars

IN 1777, when, at the suggestion of Washington, Betsy Ross made the first American flag, she stitched upon its field of blue, thirteen six-pointed stars, one for each of the original states of our union, and such were the number and shape of the stars upon the flag adopted by Congress, June 14th, 1777.

The progress of our country is clearly visioned by the increase in the number of stars which displaced the combined crosses of St. George and St. Andrew appearing upon the first distinctive American flag that indicated the Union of the Colonies, that flag first unfurled at Cambridge, Mass., Jan. 2nd, 1776. And this flag of the stars and stripes was first displayed in battle by Col. Peter Gansevoort at Fort Stanwix, now the city of Rome, N. Y., on August 9th, 1776.

The six-pointed stars gave way to stars of five points, their number increasing as our country grew, until today the flag that we love carries forty-eight stars. Such are the stars of our flag of liberty and industry.

But another star took its rightful place in the field of industry—the five-pointed star of the Coes Steel Handle Wrench, and no more appropriate symbol could have been chosen for this type of the wrench which has kept step with the stars for seventy-three years.

One hundred and four years ago, in Massachusetts, a state represented by one of these original stars, and when there were yet but eighteen stars upon our flag, Loring Coes, the maker and patentee of the first Coes Wrench, was born. Seventy-three years ago, when the stars had increased to twenty-six, that wrench was first available for man's service. Five years went by, and in 1848, when our flag bore thirty stars, the demand for "Coes" Wrenches had reached 500 to 600 per month.

The year 1869 saw 37 stars upon our flag, and the demand for "Coes" increased to 6,000 to 9,000 per month, while today, with 48 stars upon our flag, the sales of "Coes" Wrenches number over a million a year.

Just as the stars of our flag have kept step with the growth of our Nation; just as they typify strength and right service; so the star of the "Coes" Wrench has kept step with our industrial growth, and typified strength and right service, which is why it has been so aptly said:

"Coes" Wrenches Helped Make the Modern Railway Possible
"Coes" Wrenches Are Helping Make Modern Railways Profitable

Send for Catalogue and You'll See Why

COES WRENCH COMPANY, Worcester, Mass., U. S. A.

Agents: J. C. McCarty & Co.,
29 Murray St., New York.
438 Market St., San Francisco, Cal.
1515 Lorimer St., Denver, Colo.

Agents: John H. Graham & Co.,
113 Chambers St., New York.
14 Thavies Inn, Holborn Circus, London.

Oxy-Acetylene Welding and Cutting

Prest-O-Lite PROCESS

Saves Time and Money on Shop and Track Work

No matter what other welding methods you now use, you also need the Prest-O-Lite Process. In many cases the strength, economy of labor and materials so easily accomplished by this process are entirely outside the range of other welding methods. The outfit is truly portable—ready for instant use inside or outside the shop.

Progressive roads everywhere are finding oxy-acetylene welding a most valuable routine process for everyday shop and track repair and construction work.

Backed by Prest-O-Lite Universal Service

The Prest-O-Lite Process employs both gases (acetylene and oxygen) in portable cylinders. Prest-O-Lite Dissolved Acetylene (ready-made carbide gas) is backed by Prest-O-Lite Service, which insures prompt exchange of empty cylinders for full ones. Provides dry, purified gas, insuring better welds, quicker work, and lower cost, and also avoids the large initial outlay and heavy depreciation incurred in making crude acetylene in a carbide generator.

Necessary equipment is not expensive. We furnish high-grade welding apparatus for $60 (Canada, $75); acetylene service at additional cost. Adaptable for oxy-acetylene cutting by the addition of special cutting blow-pipe. Thorough instructions are furnished free to every user of Prest-O-Lite Dissolved Acetylene so that any average workman who understands metals can learn the process quickly and easily.

Write for full particulars of the Prest-O-Lite Process of oxy-acetylene welding and cutting. Address Railway Sales & Service Dept.

The Prest-O-Lite Co., Inc.

The World's Largest Makers of Dissolved Acetylene

U. S. Main Office and Factory:
807 Speedway, Indianapolis, Ind.

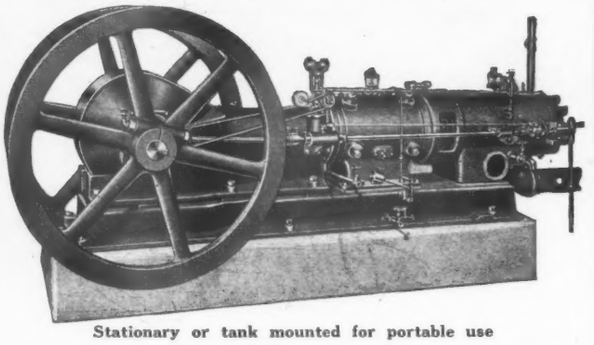
Canadian Office and Factory:
Merritton, Ontario.

53 Branches and Charging Plants

Compressed Air at Low Cost

WITH

"Chicago Pneumatic" Fuel Oil Compressors



Stationary or tank mounted for portable use

Class N-SO Compressors being self-contained readily lend themselves to the unit system for air power plants of large capacity and operate at heretofore unattainable economies, independent of boilers, engines, shafts, belts, gears, dynamos or motors. The low cost of power production and the elimination of costly losses make for cheap compressed air.

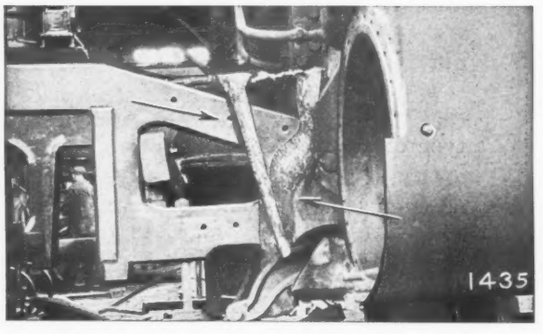
They are made in capacities up to 550 cu. ft. and will operate successfully on

Crude Oil **Stove Oil** **Diesol** **Coal Oil**
Fuel Oil **Star Oil** **Solar Oil** **Kerosene**
Residuum **Calol** **Gas Oil**

which means **low operating cost.**

CHICAGO PNEUMATIC TOOL COMPANY

1066 FISHER BUILDING CHICAGO Branches Everywhere 52 VANDERBILT AVE. NEW YORK A-4



Thermit Weld 19 Inches Long Was Made on Engine Frame and Part of Cylinder Saddle by the Southern Railway.

495 Railroad Shops Are Using Thermit

Thermit offers the only sure and reliable repair for locomotive frames and other heavy sections.

The superheated liquid Thermit steel is produced in bulk and poured all at once into a mold surrounding a broken section, resulting in the perfect amalgamation of the Thermit steel with the parts with which it comes in contact. The fact that those parts are first preheated, makes the weld doubly sure.

The operation of welding locomotive frames is easily accomplished, without removing the frame from position, and with very little dismantling, no matter if the frame be broken in the splice jaw, next to the cylinder saddle, or at any other point. The engine is returned to service in from ten to twelve hours.

Hundreds of thousands of pounds of Thermit are being used annually by railroad companies.

There is only one reason for this and that is that Thermit produces results and we all know that "results count."

Our pamphlet No. 2151 will be of interest.

GOLDSCHMIDT THERMIT CO.

120 BROADWAY, NEW YORK

329-333 Folsom St., San Francisco 103 Richmond St., W., Toronto, Ont. 7300 So. Chicago Ave., Chicago

Expert Opinion On Arc Welders

There are two types of arc welders available for railway shop use.

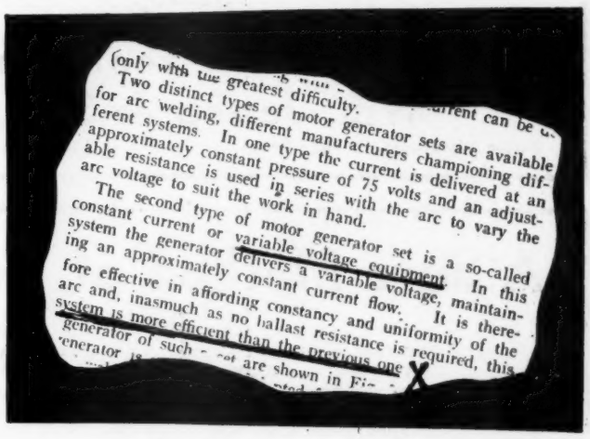
The clippings reproduced here are taken from the leading railway publications of the country. They show the opinion of capable, experienced men on the relative merits of the two types.

Lincoln Arc Welders

are *variable voltage* machines. They deliver at all times current of the exact voltage required for the work then being done. There is no resistance ballast needed in circuit to "cut down" the voltage, the power thus wasted on other types of welder is saved.

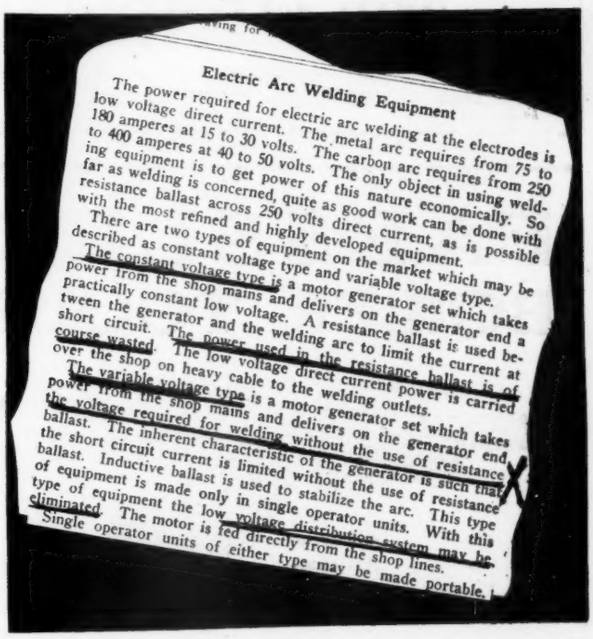
The power for the Lincoln Arc Welder is taken direct from the shop mains and does not require a heavy and expensive special distributing system to carry current to the welding stations.

There are other points of advantage in the Lincoln Welder which deserve most careful investigation. Write for our welding engineer to go over your welding problem in detail.



(only with the greatest difficulty. ...rrent can be u...
Two distinct types of motor generator sets are available for arc welding, different manufacturers championing different systems. In one type the current is delivered at an approximately constant pressure of 75 volts and an adjustable resistance is used in series with the arc to vary the arc voltage to suit the work in hand.
The second type of motor generator set is a so-called constant current or variable voltage equipment. In this system the generator delivers a variable voltage, maintaining an approximately constant current flow. It is therefore effective in affording constancy and uniformity of the arc and, inasmuch as no ballast resistance is required, this system is more efficient than the previous one. ... generator of such ... are shown in Fig. ...

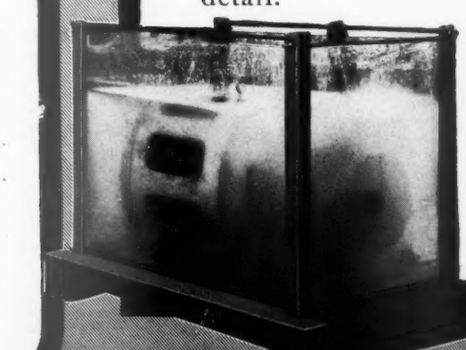
From "RAILWAY MECHANICAL ENGINEER," November, 1916.



Electric Arc Welding Equipment

The power required for electric arc welding at the electrodes is low voltage direct current. The metal arc requires from 75 to 180 amperes at 15 to 30 volts. The carbon arc requires from 250 to 400 amperes at 40 to 50 volts. The only object in using welding equipment is to get power of this nature economically. So far as welding is concerned, quite as good work can be done with resistance ballast across 250 volts direct current, as is possible with the most refined and highly developed equipment.
There are two types of equipment on the market which may be described as constant voltage type and variable voltage type.
The constant voltage type is a motor generator set which takes power from the shop mains and delivers on the generator end practically constant low voltage. A resistance ballast is used between the generator and the welding arc to limit the current at short circuit. The power used in the resistance ballast is of course wasted. The low voltage direct current power is carried over the shop on heavy cable to the welding outlets.
The variable voltage type is a motor generator set which takes power from the shop mains and delivers on the generator end the voltage required for welding without the use of resistance ballast. The inherent characteristic of the generator is such that the short circuit current is limited without the use of resistance ballast. Inductive ballast is used to stabilize the arc. This type of equipment is made only in single operator units. With this type of equipment the low voltage distribution system may be eliminated. The motor is fed directly from the shop lines.
Single operator units of either type may be made portable.

From Report of Committee on Electric Welding. Association of Railway Electrical Engineers, Oct. 31, 1916.



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Has Stood the test. Has many imitators but no equal

Manufactured in Sheffield, England

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Boston Warehouse, 163 High Street St. Louis Warehouse, 714 No. 2nd Street *Warehouses throughout the U. S.*

A Sure Method of Reducing Operating Costs

You can very materially cut the operating cost of axle lighting by adopting the E. S. B. Constant Voltage System. This system uses no pole changer, no lamp regulator and has no moving parts except the automatic switch. There is nothing to adjust in any part of the electrical equipment. The E. S. B. System assures maximum battery life by eliminating excessive overcharging and gassing. Only a minimum inspection is necessary, due to the simplicity of apparatus and lack of adjustments. Battery gassing is also eliminated, thus doubling the life of battery plates—flushing the cells only once in six months and cleaning them only once in five years.

THE ELECTRIC STORAGE BATTERY CO.

Boston Atlanta Rochester Cleveland PHILADELPHIA, PA. Detroit Chicago Denver St. Louis
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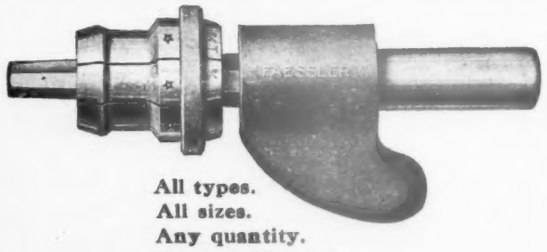
FAESSLER BOILER TOOLS



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Faessler's Safety Sectional Expander with Quick-Acting Knockout is by far the most desirable sectional expander made—the only one embodying a knockout device. Quickest, safest, most durable and most economical.

Tell us your wants and take advantage of our 60-day free trial offer, or at least ask for our Catalog No. 33.

J. Faessler Mfg. Co.

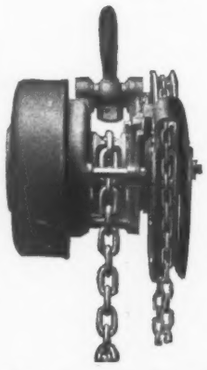
BOSS

MOBERLY, MO.
St. Louis Office: Ry. Exchange Bldg.

74

Serious Thought Should Precede the Buying of a Chain Hoist

Ford Tribloc CHAIN HOISTS



will meet all of your hoist requirements — they will enable you to handle both light and heavy loads with greater safety and at higher speeds than any other type.

Before you buy a hoist let us tell you more about the Ford Tribloc.

You will be pleased with our Catalog. Why not write for a copy?

Ford Chain Block & Mfg. Company

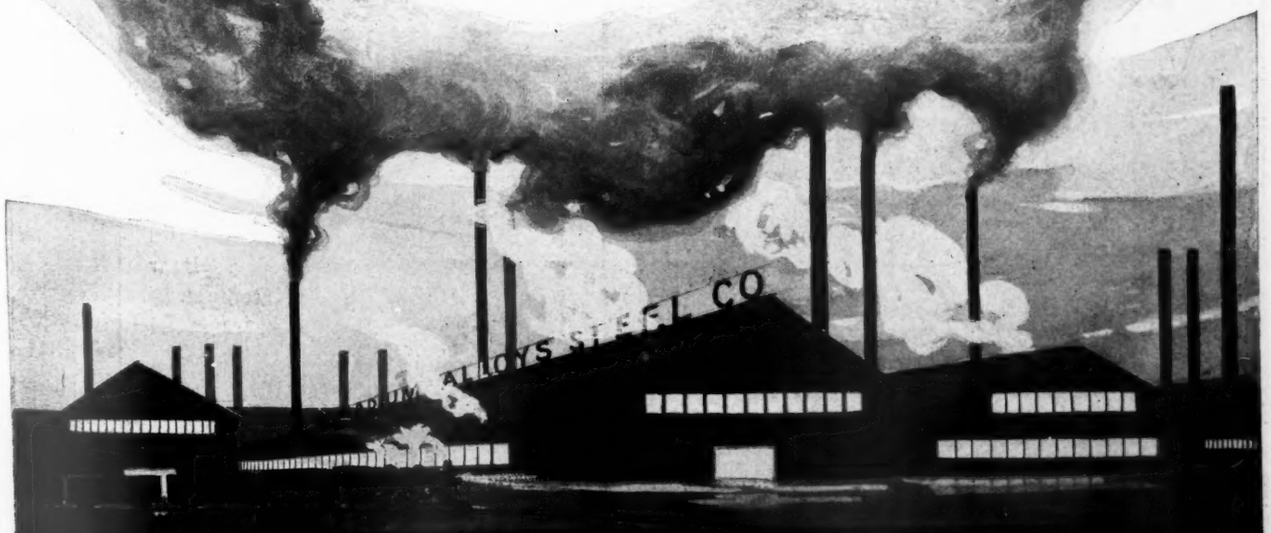
139 Oxford Street, Philadelphia, Pa.

Has it ever occurred to you that the first cost of the very best High Speed Steel is infinitesimal compared with the value of the finished tool in constant daily service.

"Red Cut Superior"

A FIRST QUALITY
HIGH SPEED STEEL

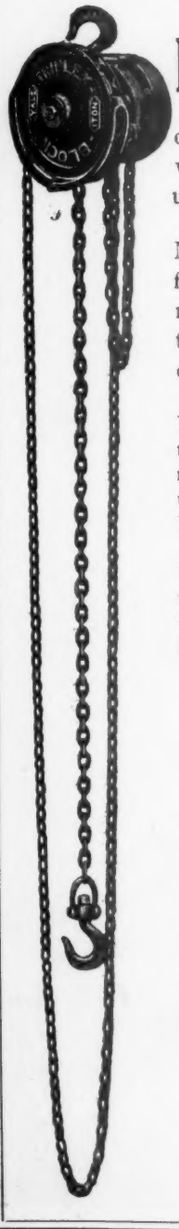
THE BEST FOR ALL MACHINE WORK



VANADIUM-ALLOYS STEEL COMPANY
General Sales Offices: Pittsburgh, Pa. Works at Latrobe, Pa

YALE

A Yale Hoist ready to lower operating chamber.



Hazardous Hoisting

on land or under the sea—is safe when Yale Triplex Blocks are used.

Making moving pictures on the floor of the ocean is risky business and every care must be taken to safeguard the operator and the expensive equipment.

Yale Triplex Blocks are selected for this dangerous work because of their recognized strength and reliability—the result of Yale Steel Vitals and Yale Safety features.

Forty years of study and specialization have developed the exclusive details that make Yale Chain Blocks best for every use.

For sale by Machinery Supply Houses.

Put your hoisting problems up to us

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For factory locking equipment use a Yale Master-key System. Write us for particulars.

The Yale & Towne Mfg. Co.

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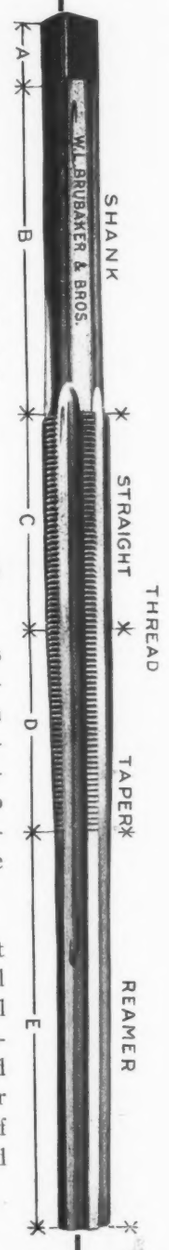
NEW YORK

BRUBAKER

Special Tempered Relieved Staybolt Taps

DON'T take our word for it! Simply address us today and ask for samples of Brubaker Taps. Try them 30 days and determine for yourself whether they are the best taps you ever tried. We know what they will do—we know they are special tempered, relieved staybolt taps and that in actual service a Brubaker Tap will tap



20% More Holes Per Tap

We can back this assertion by figures from actual tests on 25 railroads during the past year. The results from these tests have shown such unusually uniform results that we positively guarantee Brubaker Taps to give longer and more efficient service than any other make you have ever used.

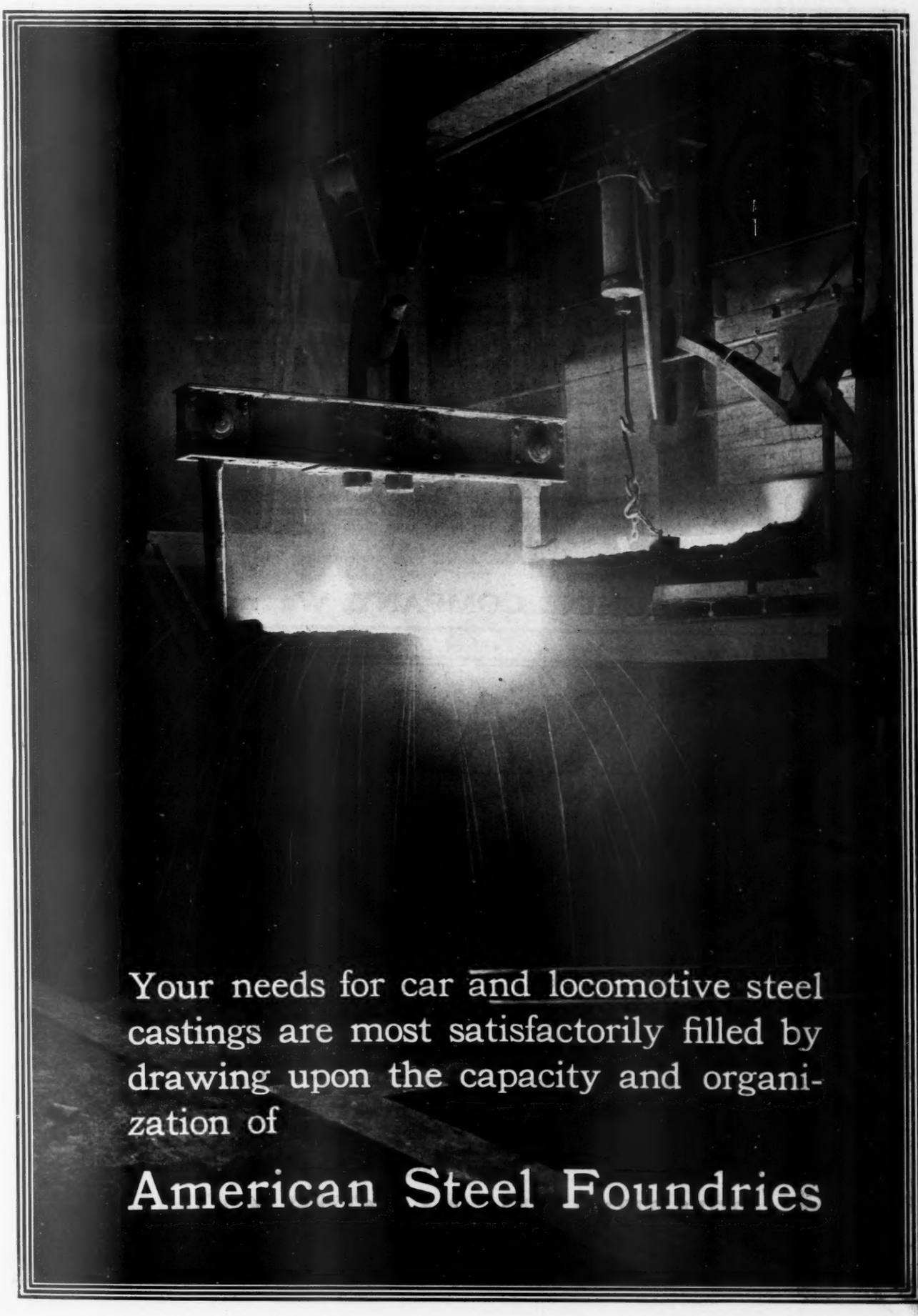
Furthermore, the Brubaker Staybolt Tap cuts easier, due to our special method of relieving. Finally actual service will prove to you that Brubaker Taps work closer to size and are more uniform in temper. Bear in mind, that the special temper of Brubaker Taps allows greater speed in motor, hence greater output.

Take advantage of our 30 day free trial offer. Send a postal today.

W. L. Brubaker & Bros.

50 Church Street, New York, N. Y.

Factory: Millersburg, Pa.


Your needs for car and locomotive steel castings are most satisfactorily filled by drawing upon the capacity and organization of
American Steel Foundries

OSTER BULLDOG RATCHET DIE-STOCKS

OSTER BULLDOG
No. 102 R
¼" to 1¼" pipe

One of eleven handy sizes with and without ratchet.

5 Big features **PLUS the ratchet** makes this the handiest, easiest stock for locomotive and other railroad use. Every pipe-threading trade knows the value of the 5 big Oster Features—(1) Self-locking dies, (2) Self-centering guides, (3) Dies open up after cut and reset automatically to size—no backing off, (4) No loose bushings, (5) No breakable parts.

Write for catalog—gladly mailed you on request

Complete catalog of 47 hand tools and machines for pipe threading.

THE OSTER MFG. COMPANY
2101 East 61st St. CLEVELAND, OHIO, U. S. A.

APPLY THE LANDIS DIE HEAD TO YOUR BOLT CUTTER

This head may be equipped for either bolt or pipe threading, either right or left hand is applicable to most standard makes of threading machines.

It is provided with an automatic opening and closing attachment which insures a quick and positive release of the die when the desired length of thread has been cut.

Furthermore the head employs the long-life Landis chaser which on account of its many efficient and economical features insures a better quality of thread, a higher production and a lower cost of die maintenance than any other threading tool on the market.

Our catalogue No. 22 will give you complete information about Landis threading equipment—write for it today.

LANDIS MACHINE COMPANY, Waynesboro, Pa.

URANIUM HIGH SPEED STEEL

Comparative Test

Cutting 6 in. Shaft, .45% Carbon

Tool	Feed	Speed, Feet per Minute	Depth of Cut	Material Cut Before Grinding
U-1	1/32"	75	5/8"	Ran 18".
U-2	1/32"	75	5/8"	Ran 13". Speed increased to 90 ft. per minute and ran 11" farther. Tool still good.
B	1/32"	75	5/8"	Ran 11".

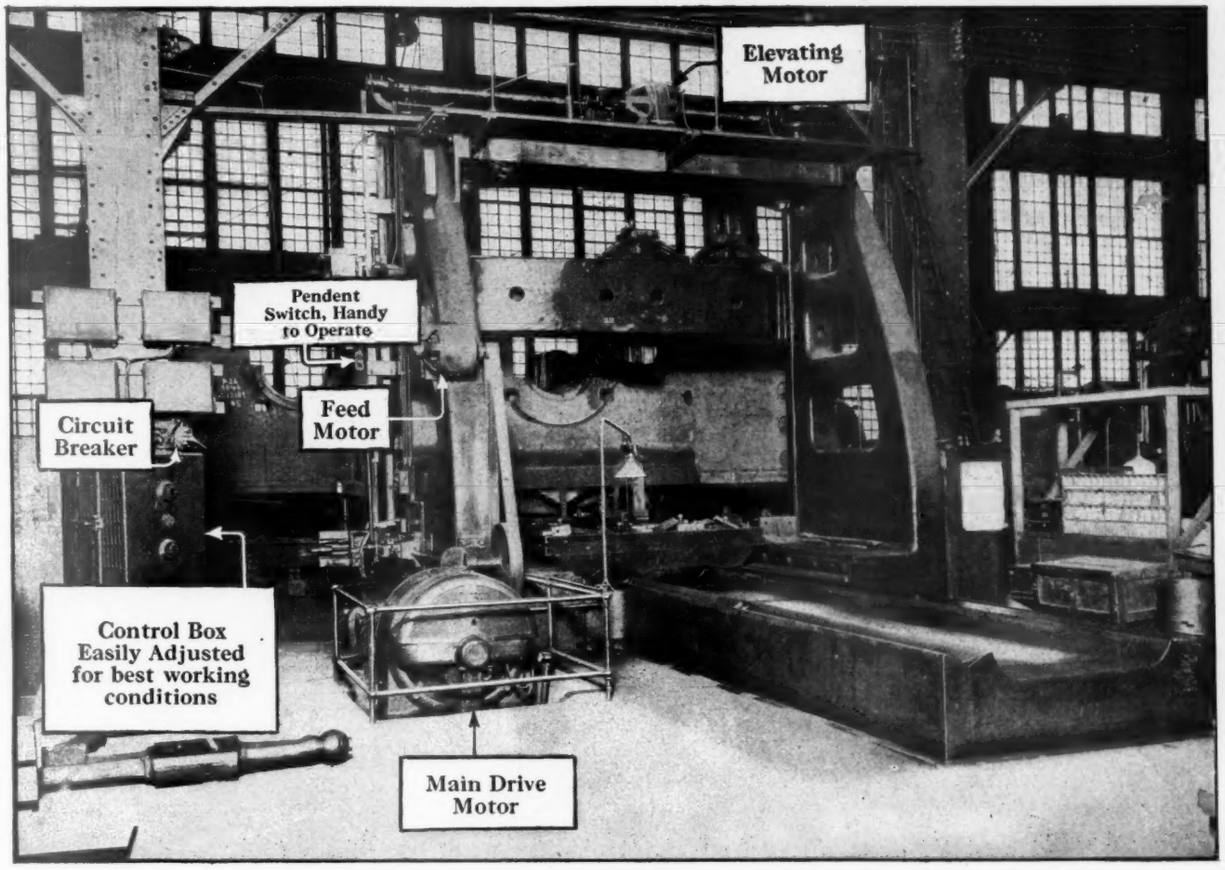
Increased efficiency, URANIUM Tools, 50% and 100%.

"URANIUM TOOLS STAND UPON THE JOB"

See your tool steel man or write us

STANDARD ALLOYS COMPANY

Forbes and Meyran Avenues **PITTSBURGH, PENNA.**



Hundreds of G-E Planer Drives are in Successful Operation

The first G-E Planer Drive, built five years ago, and hundreds built since then are in use throughout this country. Repeat orders constantly testify to their splendid operating records. Carefully consider the following advantages of this equipment:

Vastly more economical in operation and upkeep than any other existing drive.

Maximum cutting speed always sustained, giving greatly increased production.

Reverses remarkably close to a line.

Standard motor speeds 250-1,000 r.p.m.

Many speed combinations, allowing slowest cutting and highest return speed to be combined.

Freedom from shocks, giving quickest reversals possible without jar.

Unexpected return of current to wires always finds motor and control apparatus ready to receive it.

Quiet operation.

Sparkless commutation.

Trouble proof control in easy reach of operator.

This equipment is conservatively rated and has ample power. Investigate the power rating of the motor you buy.

General Electric Company

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RECLAIM YOUR OLD RAILS

THE RYERSON HIGH SPEED FRICTION RAIL SAW

THE EXPERIENCE OF ONE RAILROAD SHOP MAY INTEREST YOU:

Joseph T. Ryerson & Son, Chicago, Ill.
Gentlemen:—

To give you some idea as to what has been done with the #3 rail saw, installed at Boone rail mill August to December, wish to advise that we have cut 473,157 ft. of 90# rail making 31,543 cuts, 102,744 feet of 80# rail making 6,850 cuts, also 174,925 ft. of 72# making 11,662 cuts. During this time the saw was shut down about ten days while waiting for worm and worm gear, also a few days for loading scrap rail. We have cut as many as 354 rails in ten hours and have also made 1,244 cuts with one saw without changing.

Think the above information would be incomplete without cost per ton of 2,240 lbs. which was approximately 54c, this including unloading, cutting, drilling, reloading, and taking care of scrap rails. We cut 72# rails off in 20 seconds, which is a common occurrence.

If interested, write for catalog 9,000 and list of users

JOSEPH T. RYERSON & SON
NEW YORK CHICAGO ST. LOUIS

From A Big Man On A Big Railroad

A Message For You

We did not make any special tests along these lines, but to determine the desirability of extending superheater applications to existing engines, made a comparison from our locomotive performance sheet of several engines of the various classes with and without superheat and it developed an average saving in fuel of 23% was being obtained from the superheater.

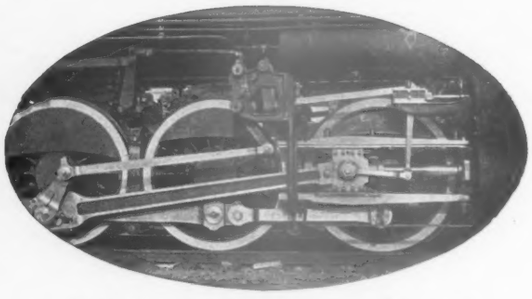
We did not, however, charge against this saving the interest and depreciation of the cost of superheater, nor any additional repairs due to the superheater alone.

The net money saving would probably be between 18% and 20%.

Yours truly,

R/b

Locomotive Superheater Co.
New York Chicago.



Baker Valve Gear

No Matter Who Builds Your Locomotives

THE Baker Valve Gear will make them better locomotives—Better because of correct steam distribution, which gives the greatest possible tractive effort with a minimum consumption of fuel; better because of the absence of the link and the various troubles due to its use; better because of standardized parts, interchangeable on locomotives of every type. In short, better locomotives because more horse power is generated per pound of coal with lower maintenance costs.

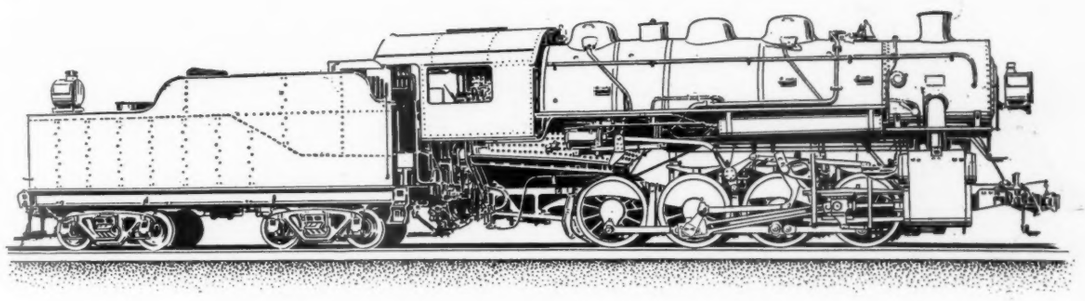
Remember that the above results are guaranteed. Write for a copy of the guarantee.

THE PILLIOD COMPANY

30 Church Street, New York, N. Y.

Western Representative, Mudge & Co., Railway Exchange, Chicago, Ill.

TERMINAL SERVICE



Congested terminals delay movement of cars and reduce operating profits.

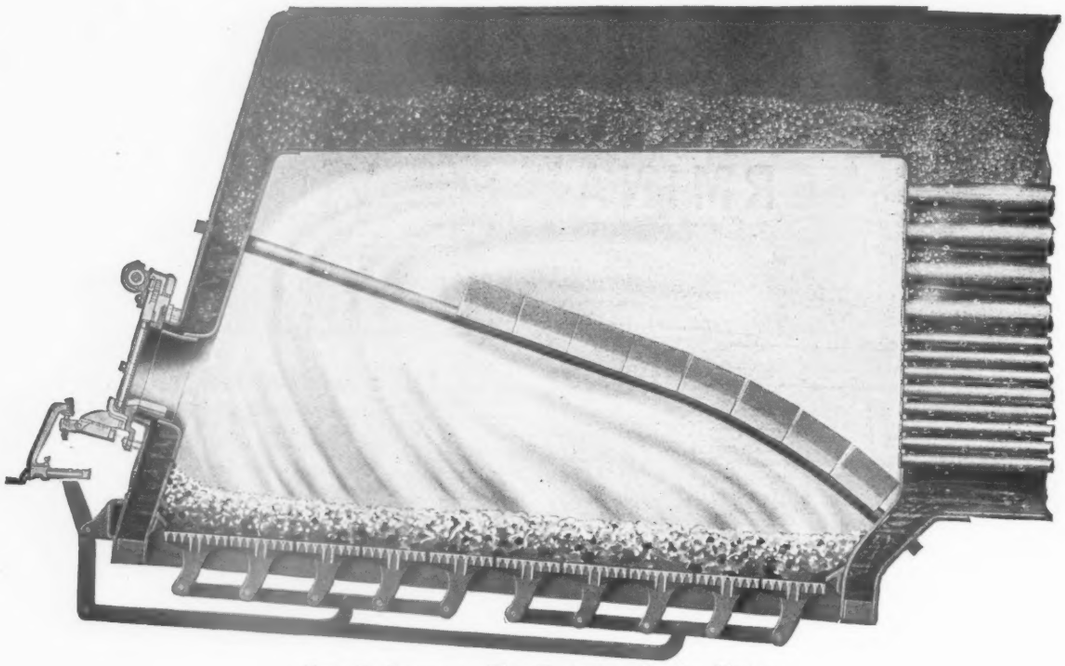
To avoid this congestion powerful, quick and efficient switchers are necessary.

A number of roads have adopted eight-wheel switchers where terminal work has outgrown the capacity of the standard six-wheel switcher, and have brought their terminal work up to the high plane to which modern freight locomotives have brought road work.

Have you considered eight-wheel switchers for your terminal service? Our engineers are available to suggest designs suitable to your needs.

AMERICAN LOCOMOTIVE COMPANY

30 CHURCH STREET, NEW YORK



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RECOGNITION

"The Arch increases the boiler capacity directly by aiding combustion and by reducing the heat losses. Naturally this results in increased boiler efficiency.

"The merits of this device are now so well known and recognized that comparatively few tests have been made during the past year to determine its efficiency."

Committee Report Travelling Engineers' Association

AMERICAN ARCH COMPANY

Specialists in Locomotive Combustion

McCORMICK BLDG.
CHICAGO

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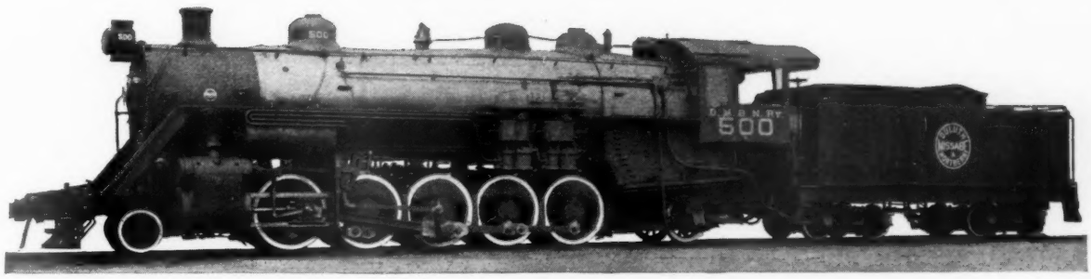
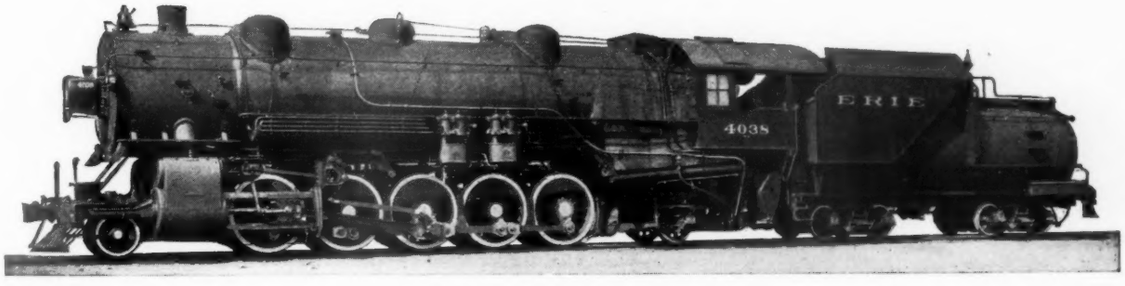
HEAVY TONNAGE MOVERS

TONNAGE—How to move a maximum amount of it over the road with existing trackage facilities —that is one of the problems to which railway officials are giving close attention.



2-10-2 Type Locomotive, Duluth, Missabe & Northern Ry.
C. W. Seddon, Superintendent Motive Power.

CYLINDERS—28 x 32 inches.
DRIVING-WHEELS, DIAM.—60 inches.
STEAM PRESSURE—185 lbs.
GRATE AREA—80 sq. ft.
WATER HEATING SURFACE—4,588 sq. ft.
SUPERHEATING SURFACE—1,128 sq. ft.
WEIGHT ON DRIVING-WHEELS—276,600 lbs.
WEIGHT, TOTAL ENGINE—346,600 lbs.
TRACTIVE FORCE—65,800 lbs.



2-10-2 Type Locomotive, Erie R. R.
William Schlafge, General Mechanical Superintendent.

CYLINDERS—31 x 32 inches.
DRIVING-WHEELS, DIAM.—63 inches.
STEAM PRESSURE—200 lbs.
GRATE AREA—88 sq. ft.
WATER HEATING SURFACE—5,660 sq. ft.
SUPERHEATING SURFACE—1,389 sq. ft.
WEIGHT ON DRIVING-WHEELS—337,400 lbs.
WEIGHT, TOTAL ENGINE—417,200 lbs.
TRACTIVE FORCE—83,000 lbs.

The 2-10-2 type is proving an effective tonnage mover, in service where 8-coupled locomotives are of inadequate hauling capacity. Further particulars will be furnished on request.

THE BALDWIN LOCOMOTIVE WORKS

PHILADELPHIA, PA., U. S. A.

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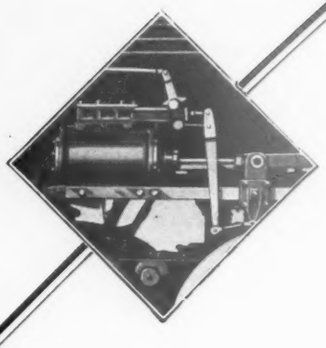


HELP WANTED

How helpless a man is when he is alone!

Perhaps he wouldn't starve but he couldn't be great.

It's much the same with locomotive improvements.

They need to be grouped, combined and effectively used.

All of them, well combined make an engine a big earner.

There's one however that improves all the rest.

It's the RAGONNET POWER REVERSE.

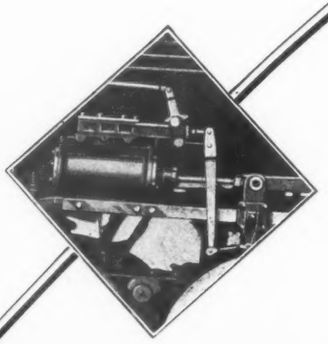
Because it facilitates the operation of the engine as a whole and insures the best use of the steam.

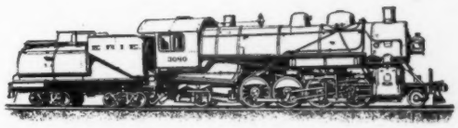
Because it handles the cut-off with power.

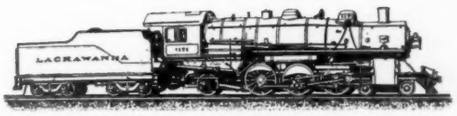
ECONOMY DEVICES CORPORATION

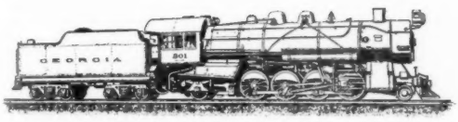
McCormick Bldg.
Chicago

30 Church Street
New York









PROFIT PRODUCING POWER

"Modern conditions are such that a difference in locomotive efficiency may account for the difference between profit and loss in railway operation.

"In certain cases and locations the efficiency of locomotives designed for heavy service and with most modern appliances, has set a high mark, in reducing the ton-mile cost of transportation.

"Whether we like it or not the financial results of operation will sooner or later depend upon the economy of power.

"The character of the motive power of a road may become the crux of the situation. With each engine adapted to give the service it is designed for, at the least expense and with the greatest certainty, operating and maintenance costs will be at a minimum."

FROM AN EDITORIAL ENTITLED LOCOMOTIVE INADAQUACY.

Lima Locomotive Works, Incorporated

Successors to Lima Locomotive Corporation

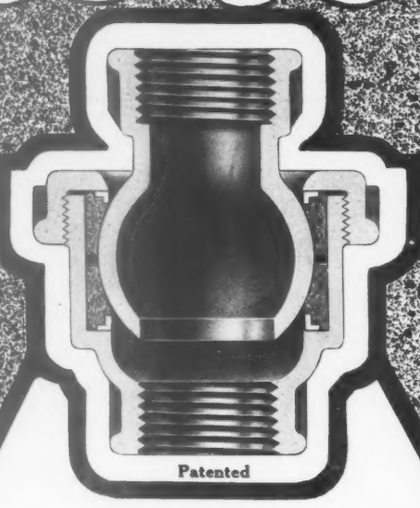
Lima, Ohio

30 Church Street New York

Barco Joints

for Engine Tender Connections

for Switch Engine Service



Perfect Freedom of Motion

Switching service is one of the best tests of the efficiency of Barco Joints for engine tender connections. The day's run of a switch engine is practically all curves and every curve brings every connection into service. Rubber is all right while it lasts but it doesn't last long enough to be a profitable investment—you hardly need a reminder about rubber hose expense.

Barco Flexible Metallic Connections stand the "gaff" of switching service or any other kind of service. Standing over a pile of hot ashes has no bad effect on Barco Joints because there is nothing to burn or rot.

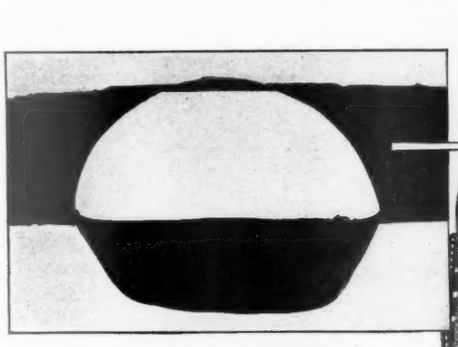
In the words of an engineer, "Barco Joints are easy on us fellows. They never let go like rubber hose, and we can forget all about our engine tender connections."

Write for Bulletins showing applications of Barco Joints to railroad work.

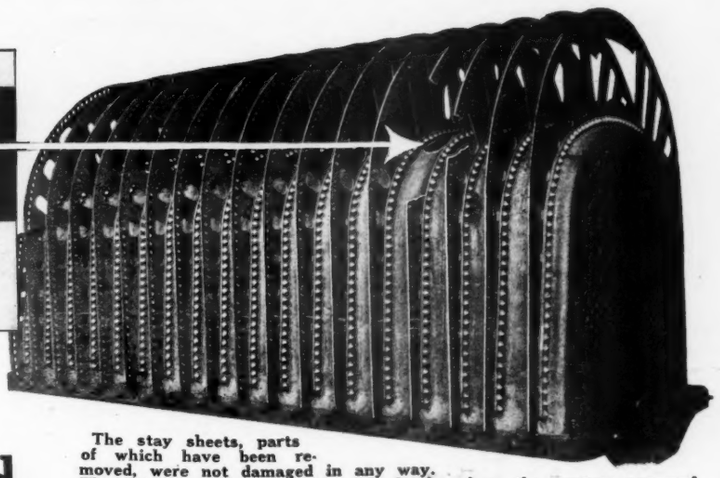
BARCO BRASS & JOINT COMPANY

212 West Illinois Street, Chicago, Ill.

A Comparison



Actual photograph of the ruptured section.



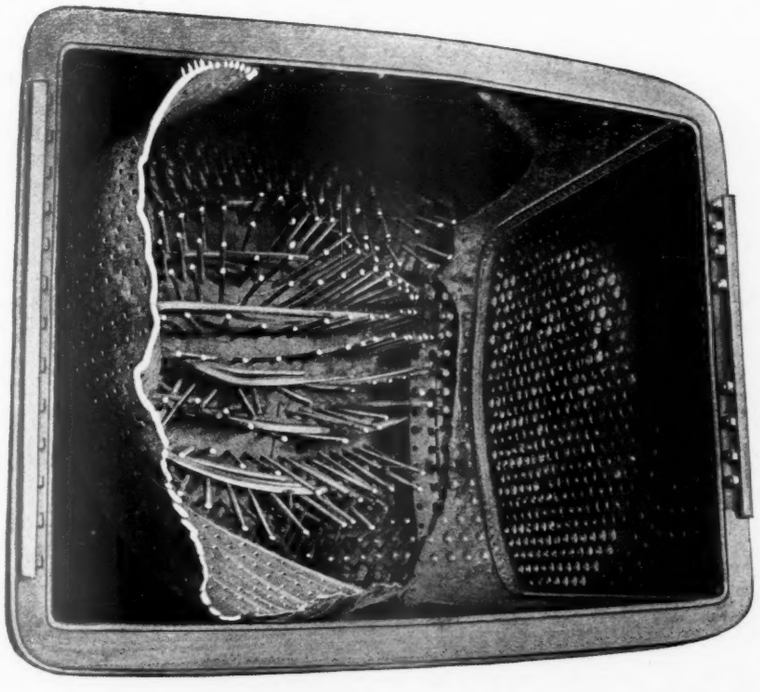
The stay sheets, parts of which have been removed, were not damaged in any way. The object is only to show more clearly where the rupture occurred.

What Happened

when recently a locomotive equipped with a JACOBS-SHUPERT FIREBOX was subjected to abnormal low-water conditions.

Only one section was ruptured and the damage, which was relatively small, was confined to the section shown.

The result conclusively demonstrates our claim of safety, and that the worst thing that can happen due to low water or accumulation of scale, is the blowing out of a single section.



What Might Have Happened

if the locomotive had been equipped with a firebox of the usual staybolt construction.

The photograph well illustrates the common result of low water on this type of box, not to mention the disastrous consequences which usually occur to both life and property.

Jacobs-Shupert U. S. Firebox Company

30 Church Street, New York, N. Y.

Works: Coatesville, Pa.

The First Line of Defense

against the attacks of boiler scale. Scale is the worst enemy of the steam boiler, large or small. The attacks of this troublesome and persistent foe are easily repulsed when your boilers are protected by

Dixon's Flake Boiler Graphite

the "Pioneer." ¶Its action is purely mechanical; gentle yet effective. By mixing with scale during its formation, the latter is rendered soft and friable and can be readily removed. ¶Your boilers will then steam freely and cleaning becomes a matter of hours instead of days. ¶This is one of the distinguishing features of FLAKE boiler graphite as prepared by the Dixon Company.

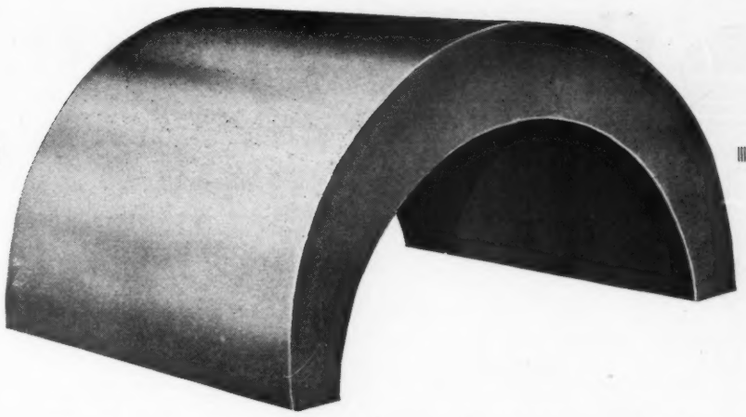
The subject is covered in detail in Booklet No. 7-T "Graphite for the Boiler."

JOSEPH DIXON CRUCIBLE COMPANY

Jersey City, New Jersey **Established 1827**

T-32

Make Your Locomotives Earn More



That means, keep them in service longer. Motive power in the shop is not only costing money to repair, but it's losing revenue besides.

You can save valuable time and the cost of labor involved in shopping power to replace defective crown bearings by using

MORE-JONES

ARCTIC

CROWN BEARINGS

— PATENTED —

Because they give twice the mileage of any other bearings—possess extra strength and double wearing quality.

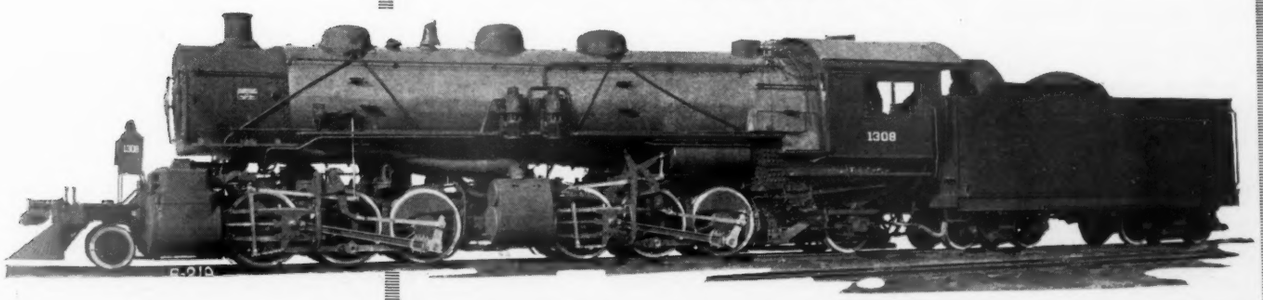
"ARCTIC" CROWN BEARINGS are cast by a special, patented process that produces a metal of close, dense, fine, uniform grain throughout, due to perfect amalgamation of all component materials. They are absolutely free from the grit and blowholes found in all sand cast bearing metal, and, therefore, have much greater strength to sustain unusual weight or thrust. Besides this, they are highly anti-frictional which saves lubrication and reduces wear on journals.

Forty years of practical foundry experience is behind the More-Jones line of railroad specialties, comprising "Tiger" Bronze Rod Brasses and Bushings, Crosshead Gibbs, Hub Liners and miscellaneous parts: "Arctic" Bronze M. C. B. Journal Bearings.

Further information and prices on application.

More-Jones Brass & Metal Co.

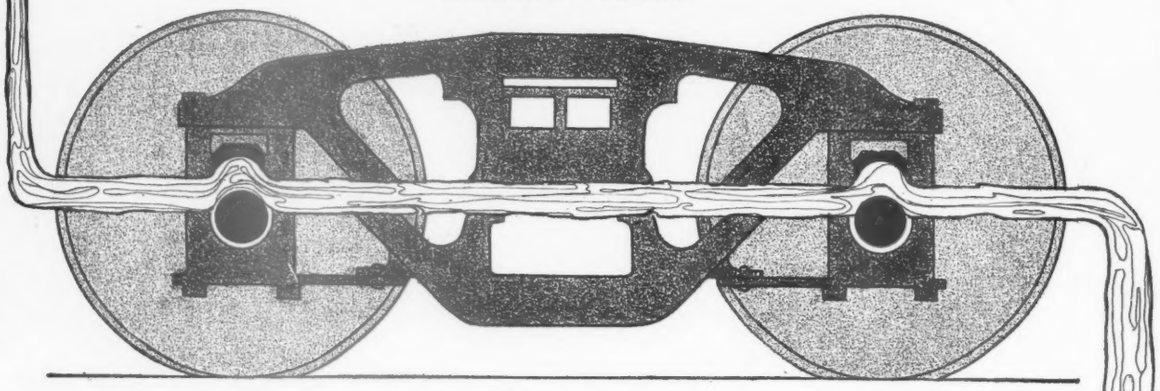
ST. LOUIS, U. S. A.



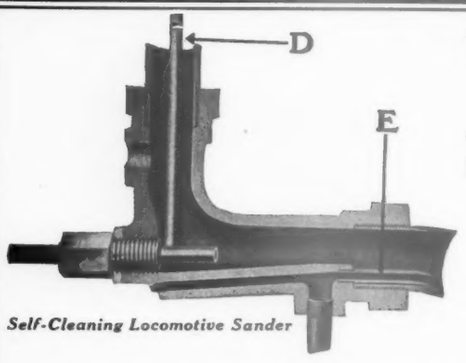
Cars Don't Run On Tracks

But they run smoothly, efficiently, and economically for all those who have availed themselves of our "Guarantee of Costs" system. Write for the details

Galena-Signal Oil Co.
Franklin Penna.



They Run On Oil



Self-Cleaning Locomotive Sander

Note These Letters "D" and "E" in this Illustration

Those letters stand for **Dependability** and **Efficiency** in Sanding, because they designate the auxiliary pipes of the

Graham-White Perfect Sander

those pipes above and below the trap which opera te from the cab and clean the sand pipe above and below the trap.

The pipe (D) extends up through the sand pipe to the dome, the other (E) down into the delivery pipe below the trap. Should the sand pipe become clogged above or below the trap, the engineer, by means of a valve in his cab, admits air into these auxiliary pipes and *instantly* cleans the sand pipe above and below the trap.

Those Letters "D" and "E" show the reason for the numerous letters received by us concerning the Dependable and Efficient service the Graham-White is rendering numerous railroads.

Don't bother to write us a letter, clip this coupon, mail it, and you will receive full particulars and facts concerning the Sander which effects direct savings from the start.

White American Locomotive Sander Company, Inc.
Roanoke **Virginia**

You Want Sand When You Want It. Then clip this coupon and mail it.

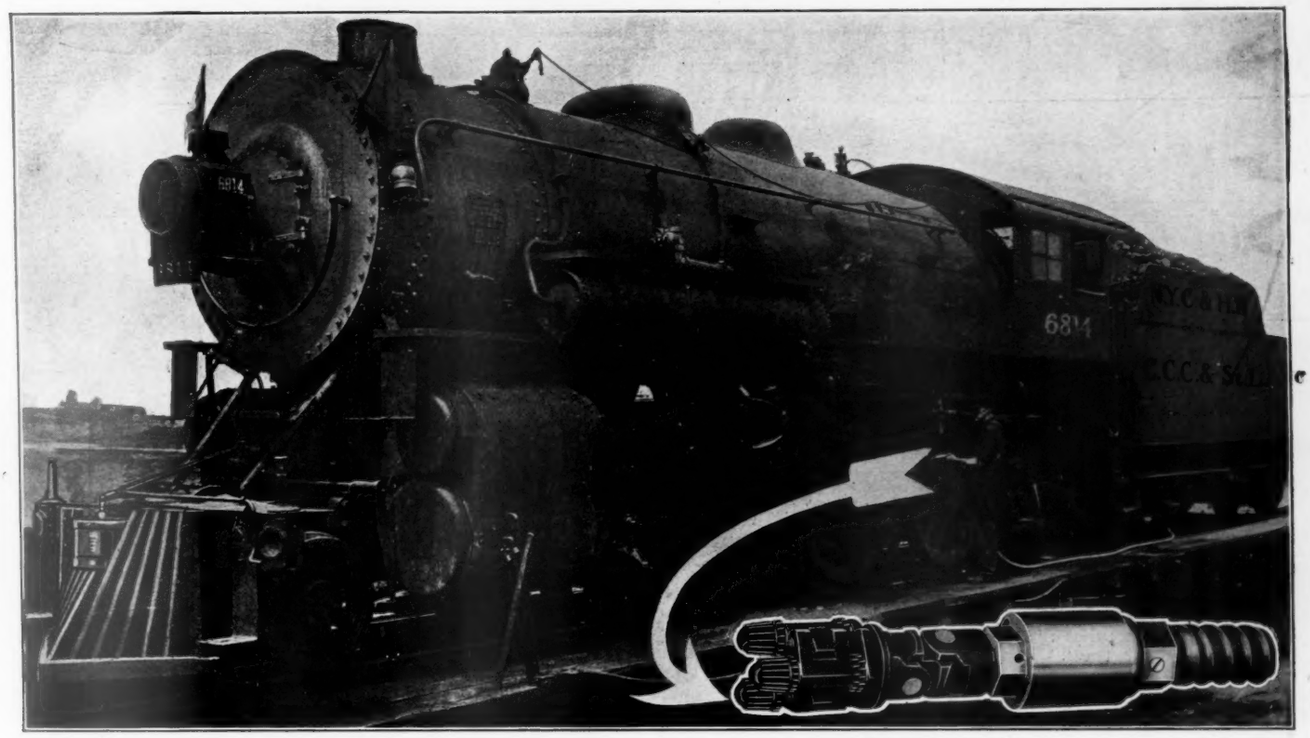
A clip of your shears—the proof appears.

Please send me details and facts about The Graham-White Perfect Sander.

Name .....

Address .....

Pin this coupon to your business letterhead or card.



Proper Cleaning of Arch Tubes

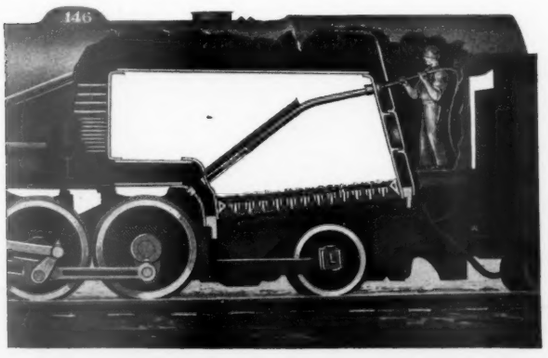
—means Lagonda Cleaners

For proper cleaning of arch tubes you want a dependable cleaner that will stand up under constant, hard service; that will work quickly but thoroughly; that is easy and economical to operate; that needs little attention.

Many of the largest and best equipped Railroads in the country know that they can depend on Lagonda Cleaners for proper cleaning of the arch tubes. And proper cleaning pays. Prove it.

Request Bulletin W-30

(The cut below was made originally by us and used for years.)



Cleaners for Delivery Pipes

Lagonda Cleaners used periodically in cleaning Delivery Pipes will make it unnecessary to renew them. See our Bulletin W-30.

The Lagonda Mfg. Co.
SPRINGFIELD, OHIO.
NEW YORK, BOSTON, PHILADELPHIA, ST LOUIS, CHICAGO, DETROIT, DENVER, DALLAS, SAN FRANCISCO, ST. PAUL, MONTREAL, LONDON.
FUEL SAVING SPECIALISTS

Makers of Lagonda Boiler Tube and Condenser Cleaners, Tube Cutters, Automatic Valves, Strainers, Grease Extractors.

(342)

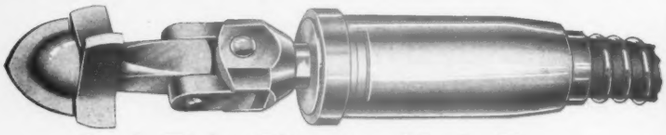
Jenkins Bros. Valves

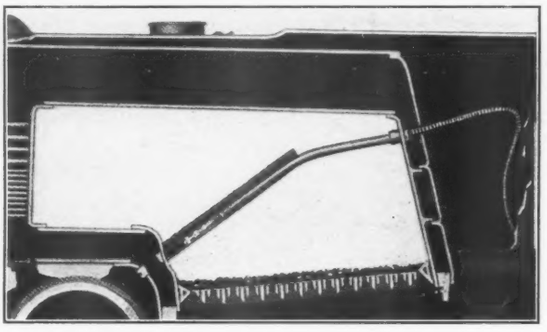
The **Extra Heavy Pattern** Jenkins Bros. Valves cover the most rigid requirements for maintained tightness and endurance.

Made in brass, in iron body, and in cast steel.

The Jenkins Bros. catalog gives full details regarding sizes, dimensions, construction and application. Ask for RM20.

JENKINS BROS., New York Philadelphia Boston Chicago





Arch Tube Cleaning Made Easy

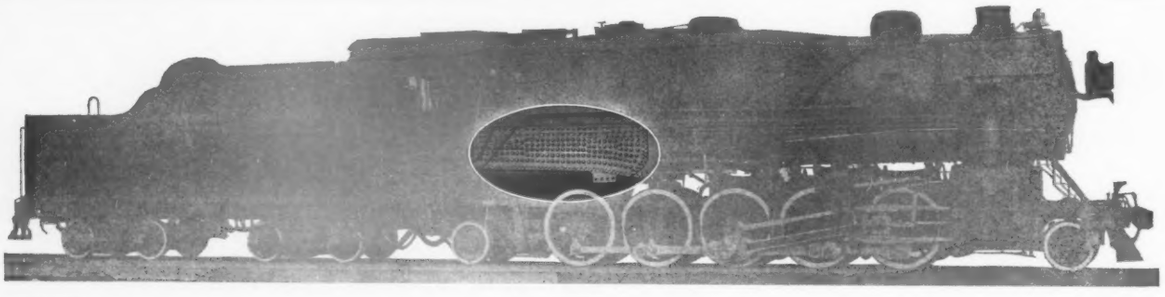
Cleaning arch tubes made easy and simple; that is the service performed by the

Roto Arch Tube Cleaner

Operated by a standard 9½ inch air pump

Notice its tapered form which permits it to pass easily around the bends of a 3" arch tube. With the Roto, arch tubes are cleaned much faster than by any other arch tube cleaner. Why? Send for Bulletin No. 44 and get the full answer.

THE ROTO COMPANY, Hartford, Conn.



This Locomotive

represents the latest practice in modern design and is the result of the best thought of locomotive designers and builders. Among its many notable features planned to withstand exceptionally hard service conditions are

Break-Less Staybolts

These staybolts not only provide a bolt which from a mechanical standpoint is ideal on account of its simplicity and strength; but they also improve firebox construction due to the fact that they remain flexible at all times without the complications of sleeves and caps and that their application does not structurally weaken the firebox.

Write for Descriptive Pamphlets

THE BREAKLESS STAYBOLT COMPANY

PITTSBURGH, PENNA.

When Did We Install This Pipe?

Service Records of Byers Pipe

Hostetter Bldg., Pittsburgh, Pa.—Byers pipe in heating and plumbing system required no repairs in 37 years, and still in use.

Castle Kid Co , Camden, N. J.—"Get on an average at least twice the time service from Byers as from any other pipe tried".

Tacoma Building, Chicago, Ill.—90% of Byers pipe installed 27 years ago still in service. Minimum life of Byers 16 years. Minimum life of other pipe in SAME SERVICE ONE YEAR.

Xenia Water Co., Xenia, Ohio—No leak in Byers in 26 years. Three leaks in steel pipe after 5 years use. Lines laid side by side underground.

Brooks Son, Dayton, Ohio—Byers ¾" underground service line removed, in good condition after 45 years' service.

Y. M. C. A. Railway Branch, St. Louis, Mo.,—Steel pipe in heating and plumbing system rusted out in 7 years and replaced with Byers throughout the building.

Philadelphia Co., Pittsburgh, Pa. Byers pipe after being in ground 28 years, showed only 2½% loss through corrosion.

Fortune Bros. Brewing Co., Chicago, Ill.—Byers used in refrigerating coils torn out after 20 years service Pipe in such good condition that it was used again.

Walker Bldg., Dexter Bldg., Van Dyke Apartments and a number of other Buildings in Chicago—Byers pipe installed from 25 to 30 years ago, and never given any trouble. Still in place, giving good service.

Waterloo Water Works—Waterloo, Ia—Steel casing rusted out in 7 years. Wrought Iron casing still good after being in the same ground from 20 to 30 years.

When did we install this pipe? That becomes a vital question only after years of service. But just as you may be asking this question NOW about pipe purchased 5, 10, 20, 30 or more years ago, so you or some one else will, some day, be asking the same question about the pipe *you are buying now.*

Do not allow this question ever to become a reflection on your buying judgment; look at the purchase of pipe from the standpoint of *lowest cost per year,* and you will invariably specify

BYERS GENUINE WROUGHT IRON FULL WEIGHT GUARANTEED **PIPE**

Byers will never leave any doubts as to WHEN it was installed, for the year of manufacture is rolled on every length.

Byers will never make anyone wonder why it didn't last longer, but rather why it lasted so long.

For nothing but the strongest FAITH—FAITH based on KNOWLEDGE of how Byers is made and how it lasts—could have induced Byers, alone of pipe manufacturers, to put "The Year on Every Length".

"The Year on Every Length" is an open invitation to pipe users to watch and compare the service given by Byers with that of iron and steel pipe of whatever make, brand or character.

Send for Byers Bulletin No. 26 of useful pipe information. Every pipe user will find it of value. Sent Free on Request.

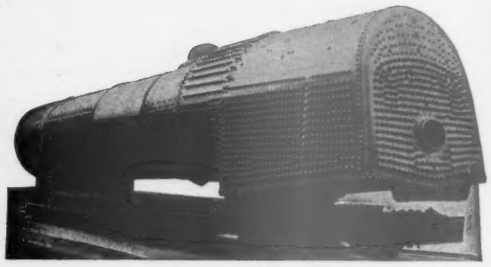
A. M. BYERS COMPANY, PITTSBURGH, PA.

ESTABLISHED 1864

23 Sullivan Street	11 Sleeper Street	720 Fulton Street
NEW YORK CITY	BOSTON, MASS.	CHICAGO, ILL.

DISTRIBUTORS IN ALL JOBBING TOWNS

"The Year on Every Length"
Byers Covenant with the Pipe User



TATE FLEXIBLE STAYBOLTS

THE RECOGNIZED STANDARD FOR LOCOMOTIVE FIREBOXES

SERVICEABILITY PLUS ECONOMY

The Tate Bolt has fully demonstrated its true functions as a mechanical appliance to serve the firebox requirements. Flexibility must be maintained—the only positive assurance of flexibility is the use of the Tate Flexible Staybolt.

Many of the largest railroad systems have kept accurate service records and show remarkable increase in earning power of the locomotives that have been equipped with complete installations of the Tate Flexible Staybolt.

Flannery Bolt Company

PITTSBURGH, PA., U. S. A.

GEN'L OFFICES, VANADIUM BUILDING. E. D. STAFFORD, GEN'L MANAGER

J. ROGERS FLANNERY & COMPANY, SELLING AGENTS. VANADIUM BUILDING, PITTSBURGH, PA.

GEO. E. HOWARD, EASTERN TERRITORY. W. M. WILSON, WESTERN TERRITORY.

COMMONWEALTH SUPPLY CO., SOUTHEASTERN TERRITORY

CHARLES HYLAND, BOILER EXPERT

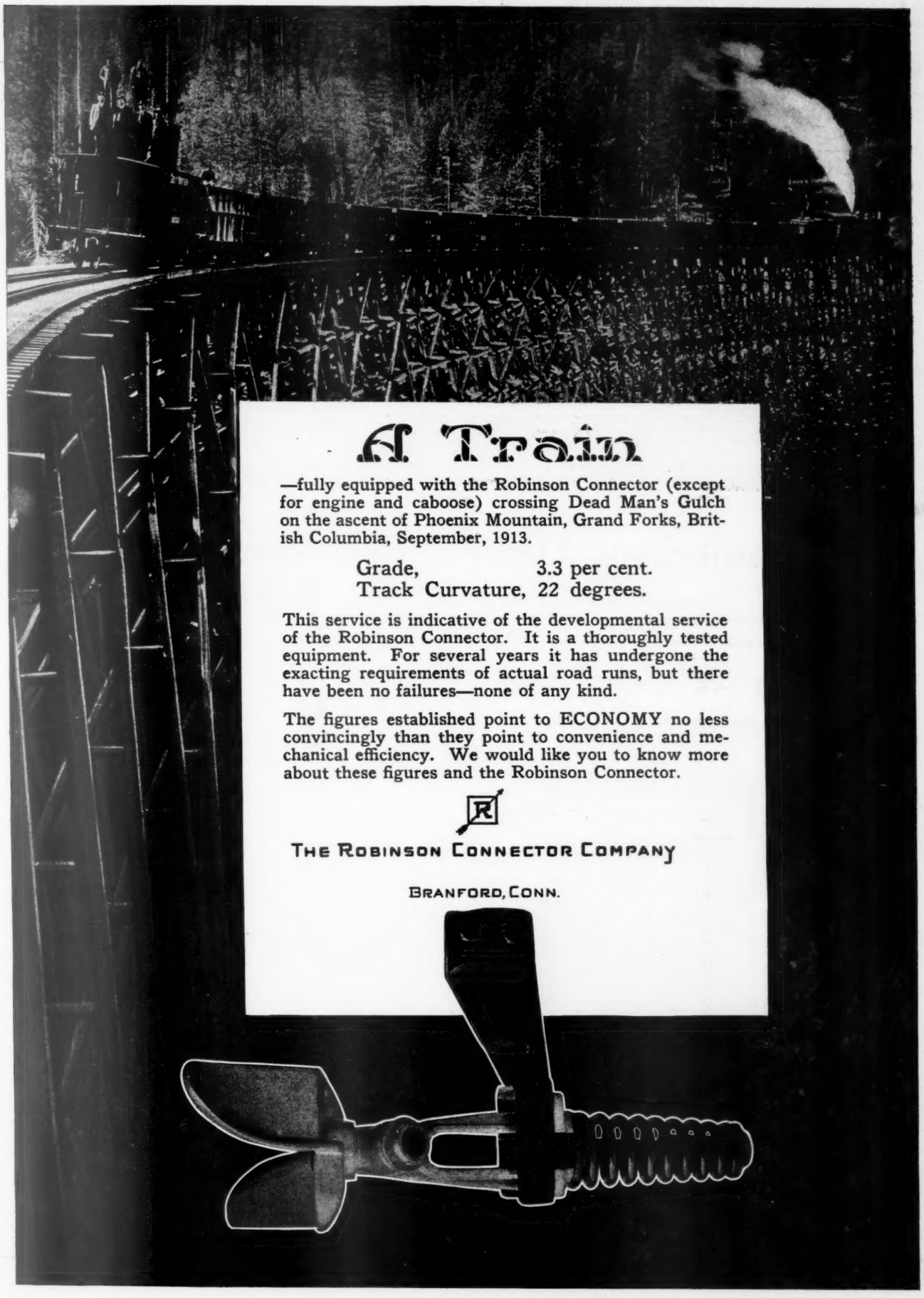
Lukens

One hundred years of effort by four generations of master steel makers has resulted in the production of Locomotive Firebox and Boiler Steel of such a standard of excellence that to all users throughout America

Lukens Signifies Quality

LUKENS IRON & STEEL CO.

Coatesville Penna.



A Train

—fully equipped with the Robinson Connector (except for engine and caboose) crossing Dead Man's Gulch on the ascent of Phoenix Mountain, Grand Forks, British Columbia, September, 1913.

Grade, 3.3 per cent.
Track Curvature, 22 degrees.

This service is indicative of the developmental service of the Robinson Connector. It is a thoroughly tested equipment. For several years it has undergone the exacting requirements of actual road runs, but there have been no failures—none of any kind.

The figures established point to ECONOMY no less convincingly than they point to convenience and mechanical efficiency. We would like you to know more about these figures and the Robinson Connector.

THE ROBINSON CONNECTOR COMPANY

BRANFORD, CONN.

The Railway Materials Company

Steel Back Brake Shoes

Railway Exchange CHICAGO

Singer Building NEW YORK

2

The American Staybolt

American Flexible Bolt Company

Chicago McCormick Bldg. | Pittsburgh Union Bank Bldg. | New York 50 Church Street | Montreal and Winnipeg Taylor & Arnold, Ltd.

Ashton Wheel Press Recording Gages

Ashton Wheel Press Recording Gages give an accurate record of wheel fits on axles, showing actual fit from start to finish, insuring perfect mountings.

Send for special circular which gives full details, also catalogue describing our complete line of Specialties.

The Ashton Valve Co.

BOSTON, MASS. 271 Franklin St. | CHICAGO, ILL. 608 So. Dearborn St.

Bad Water

The bad waters used in the western part of the country—because they are the only available supplies—have been improved so much by scientific treatment, that officials operating in the eastern or good water belts are often surprised to find that roads operating in the bad water districts are beating their boiler performance, both as to life and cost of maintenance.

Investigation of the subject brings out the fact that there is very little water being used for steam purposes that cannot be improved by scientific treatment, the only problem being whether or not the cost of the treatment is greater than the savings effected.

The reason that all roads that have thoroughly investigated this subject are using Dearborn Treatment is because they have always found the cost of Dearborn Treatment to be only a small percentage of the savings effected by its use.

If you are having trouble with bad water, or want to know how to improve so-called "good" water, write us, and we will be glad to explain our work fully and advise regarding your needs.

Dearborn Chemical Company

McCormick Building Chicago

1-5

PANTASOTE

THE National Standard for car curtains and car upholstery. Twenty years' service tests have established its superiority to any other curtain material.

AGASOTE

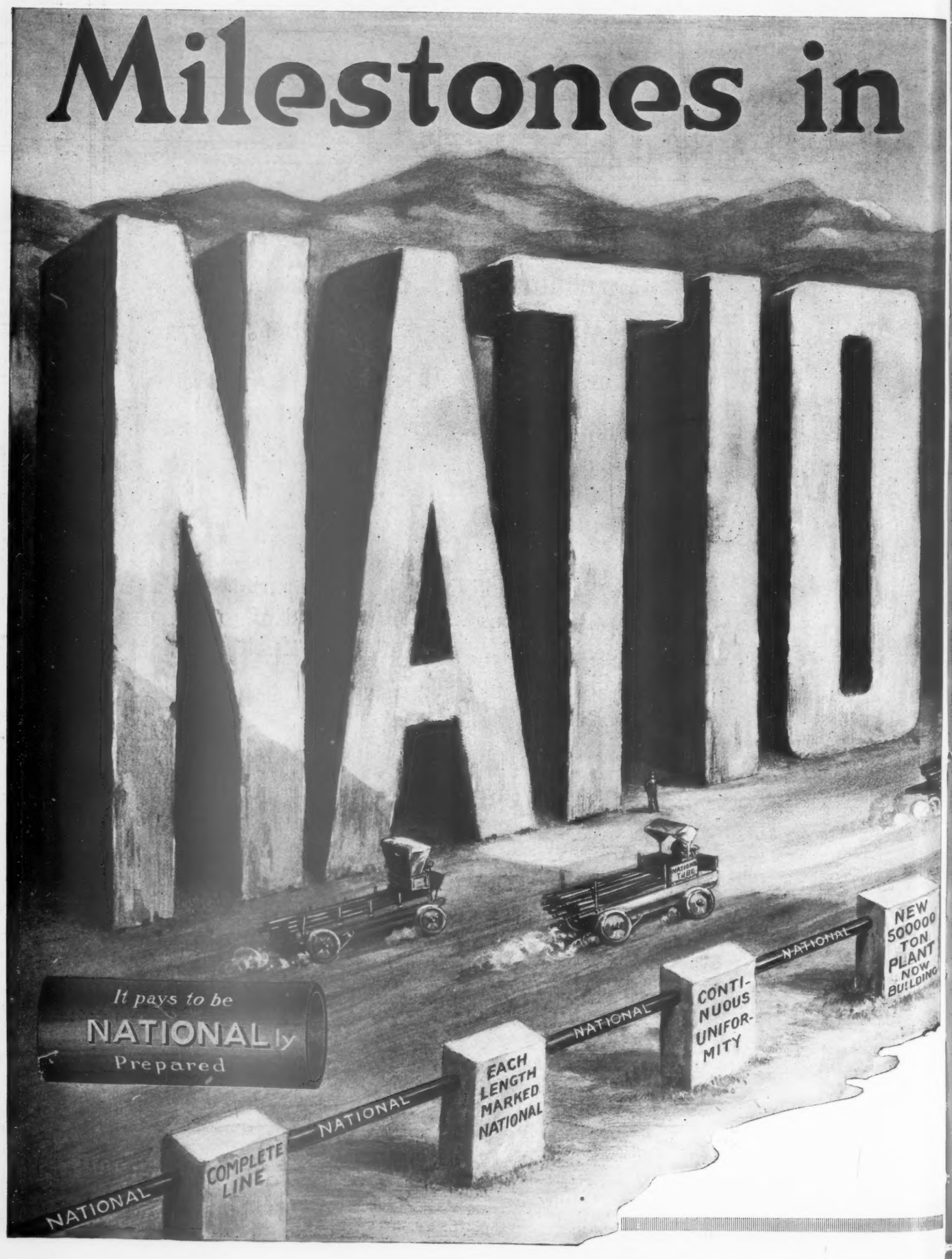
FOR car headlinings and interior trim. A homogeneous waterproof board of great density and tensile strength. It will not warp, blister or separate.

NON-CONDUCTIVE qualities of heat and cold make it peculiarly well adapted for headlining and interior trim for steel fireproof passenger cars, entirely eliminating the disadvantage of steel for interior trim and giving the appearance of wood finish.

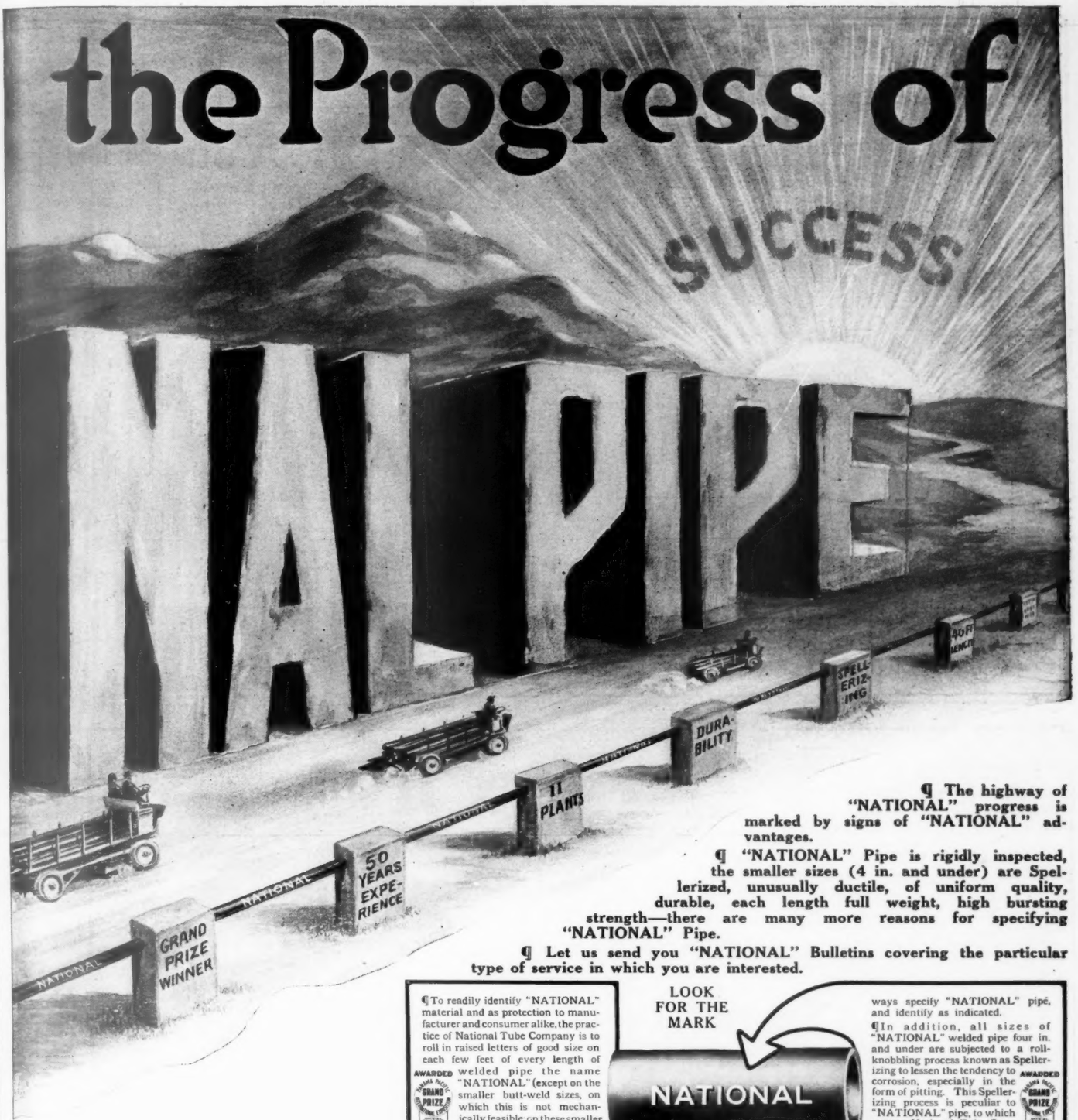
THE PANTASOTE COMPANY

11 Broadway, New York **Peoples Gas Building, Chicago**

797 Monadnock Building, San Francisco


Milestones in
NATIO
It pays to be
NATIONALly
Prepared
NATIONAL
COMPLETE LINE
NATIONAL
EACH LENGTH MARKED NATIONAL
NATIONAL
CONTINUOUS UNIFORMITY
NATIONAL
NEW 500000 TON PLANT NOW BUILDING

the Progress of



¶ The highway of "NATIONAL" progress is marked by signs of "NATIONAL" advantages.

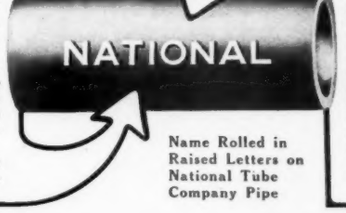
¶ "NATIONAL" Pipe is rigidly inspected, the smaller sizes (4 in. and under) are Spellerized, unusually ductile, of uniform quality, durable, each length full weight, high bursting strength—there are many more reasons for specifying "NATIONAL" Pipe.

¶ Let us send you "NATIONAL" Bulletins covering the particular type of service in which you are interested.

¶ To readily identify "NATIONAL" material and as protection to manufacturer and consumer alike, the practice of National Tube Company is to roll in raised letters of good size on each few feet of every length of welded pipe the name "NATIONAL" (except on the smaller butt-weld sizes, on which this is not mechanically feasible; on these smaller butt-weld sizes the name "NATIONAL" appears on the metal tag attached to each bundle of pipe).

¶ When writing specifications or ordering tubular goods, always specify "NATIONAL" pipe, and identify as indicated.

LOOK FOR THE MARK



Name Rolled in Raised Letters on National Tube Company Pipe

¶ In addition, all sizes of "NATIONAL" welded pipe four in. and under are subjected to a roll-knobbling process known as Spellerizing to lessen the tendency to corrosion, especially in the form of pitting. This Spellerizing process is peculiar to "NATIONAL" pipe, to which process National Tube Company has exclusive rights.

¶ "NATIONAL" pipe was awarded the GRAND PRIZE (highest possible award) at Panama Pacific International Exposition, 1915.

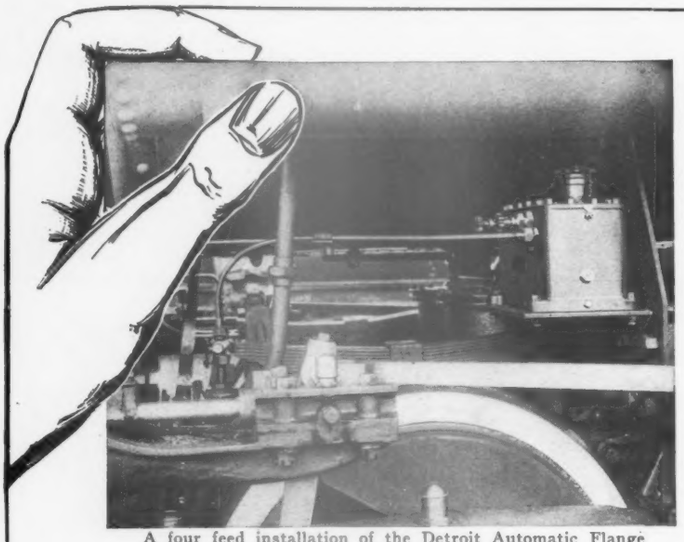
NATIONAL TUBE COMPANY

General Sales Offices:
FRICK BUILDING, PITTSBURGH, PA.

DISTRICT SALES OFFICES

Atlanta Boston Chicago Denver Kansas City New Orleans New York Omaha
Philadelphia Pittsburgh Salt Lake City St. Louis St. Paul

Pacific Coast Representatives: U. S. STEEL PRODUCTS CO., San Francisco, Los Angeles, Portland, Seattle
Export Representatives: U. S. STEEL PRODUCTS CO., New York City



A four feed installation of the Detroit Automatic Flange Oiler on a Mikado Type Locomotive.

We Offer You

Greatly Increased Tire Mileage;
Additional Life Of Rails on Curves;
Efficiency, Economy and Safety

and all the advantages and economies resulting from

Efficient Flange Lubrication

conclusively demonstrated through the extensive investigations conducted by the American Railway Master Mechanics' Association, and proved through the actual service on so many leading railroads of the

DETROIT AUTOMATIC FLANGE OILER

the most efficient and practical device on the market for securing Flange Lubrication, and the product of the oldest and largest manufacturers of lubricating devices in the world.

Send for Booklet FO-75 which tells why you should

Let The Pendulum Do The Work

Detroit Lubricator Company, Detroit, U. S. A.

Canadian Detroit Lubricator Company, Ltd., Walkerville, Ontario **Makers of Stewart Carburetors**

THE PENN COUPLER

Our latest development of the M. C. B. Coupler, a modification of our popular Pitt and Janney X Couplers, with latest improvements.

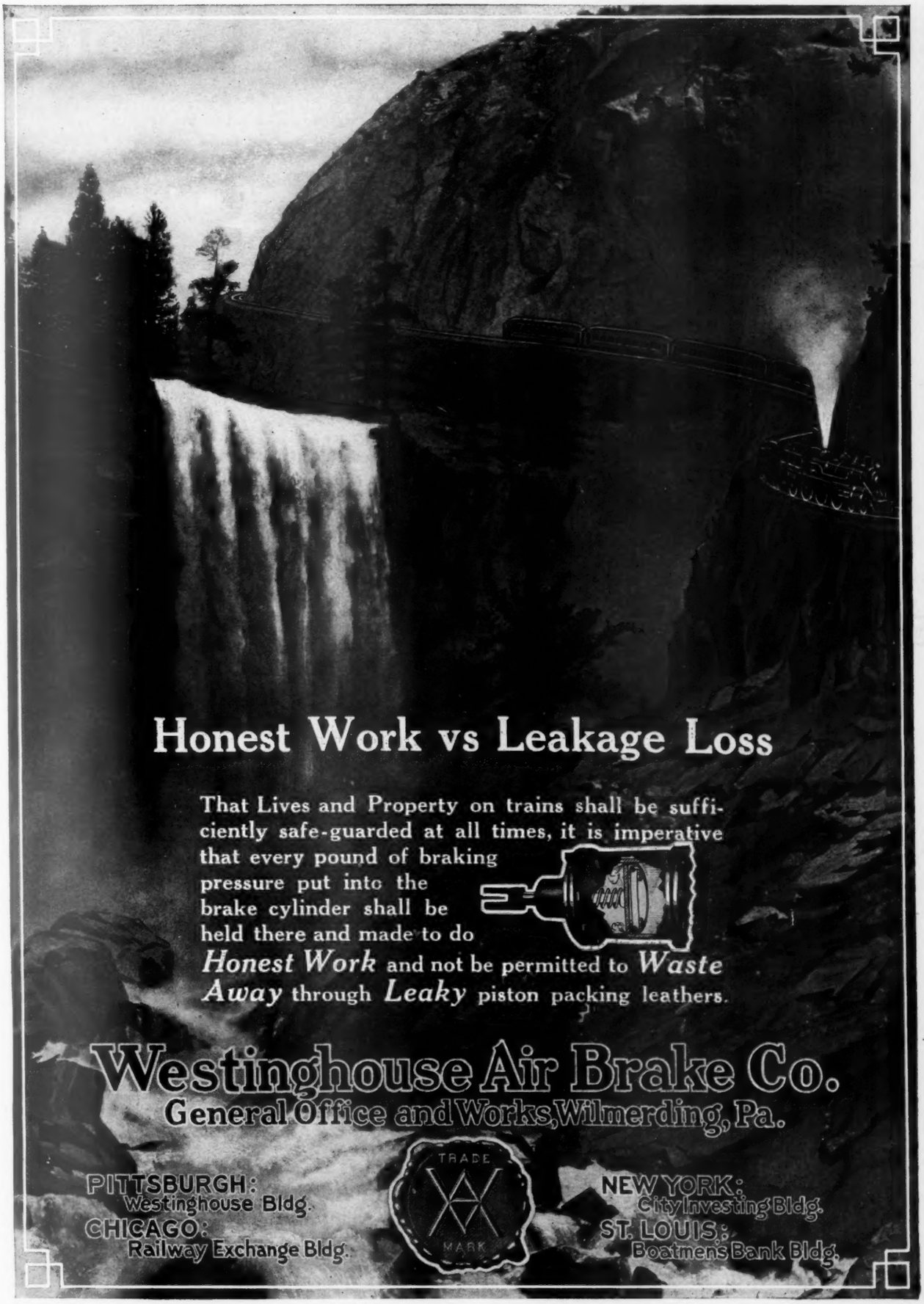
Lock-To-The-Lock
Lock-Set and
Knuckle-Opener

Send for blueprints and prices.

Manufactured only by

THE McCONWAY & TORLEY CO.

PITTSBURGH, PA.


Honest Work vs Leakage Loss
That Lives and Property on trains shall be sufficiently safe-guarded at all times, it is imperative that every pound of braking pressure put into the brake cylinder shall be held there and made to do
Honest Work and not be permitted to Waste Away through Leaky piston packing leathers.
Westinghouse Air Brake Co.
General Office and Works, Wilmerding, Pa.
PITTSBURGH:
Westinghouse Bldg.
CHICAGO:
Railway Exchange Bldg.
TRADE
MARK
NEW YORK:
City Investing Bldg.
ST. LOUIS:
Boatmens Bank Bldg.

Something New in Unions

A Union that locks tight, tightens as it locks, and stays locked regardless of vibration or expansion and contraction.

Here is a new idea in Unions—a Union that **locks.** Created by a railroad man to meet the exceptionally severe requirements of railroad work.

STALOCK UNIONS

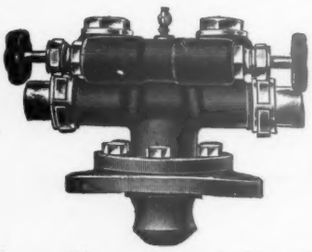
Simplicity is the keynote of the locking principle of the "Stalock" Union. When the union is tightened in place, at least two diametrically opposite lugs are always in locking position. A blow of the hammer or wrench on the malleable iron lug bends it over and locks it in position.

Write for complete literature and prices.

Standard Union Company

612 Winthrop Building, Boston, Mass.

Double Boiler Check Valve



The position of this valve is on top of the boiler. It is provided with a stop valve for each check valve, so that either one of the check valves, if out of order, may be "cut out" without interfering with the feeding of the boiler. Removable caps on top of each check permit inspection and grinding of valves without disconnecting pipes.

Simple and pleasing design, compact and efficient. Furnished complete with boiler flange.

Write for Catalog

NATHAN MANUFACTURING CO.
101 PARK AVE NEW YORK

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STEEL users everywhere, the Railroads and
CAR companies of America; the Companies that
FORGE ahead due to their wise management, know the
COMPANY noted for Universal High Quality Products.

"The Forging Specialists"

It will pay ***You*** to let ***Us*** estimate on the heavy and light forgings your road requires.

Send For Our Catalogue.

STEEL CAR FORGE COMPANY

Forging Specialists

Pittsburgh - - Penna.

"Shoemaker, Stick to Thy Last"

SAVE THE GEARS

COMING in on the train the other day, I read a dandy little book sent out by a gear manufacturer.

It gave a list of causes for noisy gears. Some of them are:

1. Eccentrically machined blank
2. Blanks machined oversize
3. Meshing to incorrect depth
4. Insufficient lubrication

There were other reasons, but these are typical.

Now, here's my point. The first three are beyond our control. We cannot claim to tell the Gear Cutter anything new about his end—nor can we hope to show your skilled mechanics much in the way of lining up gears and shafting.

But, LUBRICATION—that's OUR business, and lubrication of gears, as evidenced by the success of TEXACO CRATER COMPOUND, is peculiarly our business.

You will note that the manufacturer says, "Insufficient lubrication." He doesn't mean that too little lubricant is put on the gears. He knows that, as a rule, too little lubricant STAYS on the gears. And it is just by overcoming this that CRATER is making its way into shop after shop.

CRATER stays where it is put. You apply it to a set of gears and it stays there, stays on the wearing surfaces. It provides not only sufficient lubrication but *efficient* lubrication. Efficient because it does the work, because a little CRATER lasts a long time and because it doesn't splash over the machine (the operators like this).

The film of CRATER COMPOUND coats the wearing surfaces of the teeth, prevents metallic contact, cutting, wear and NOISE. That reduction of noise is a sign of the thorough lubrication and protection provided by CRATER.

Many wide-awake machine shops have taken advantage of our make-good offer: we will ship you express prepaid a 25-lb. can of TEXACO CRATER COMPOUND on a strictly approval basis. You pay for it after it has made good.

Some of the largest gear manufacturers have come to us to secure Efficient and Sufficient Lubrication

The CRATER BOOK tells about it. Write for your copy today

There is a Texaco Lubricant for every purpose

TEXACO

THE TEXAS COMPANY

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Houston Chicago New York

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TEXACO

The National Extended Floor Engine Coupler Pocket

Supports the Coupler-Head at a point well forward and near its center of gravity. This method of support maintains the coupler-head in horizontal position and prevents its sagging.

Vertical adjustment secured by the use of shim washers.

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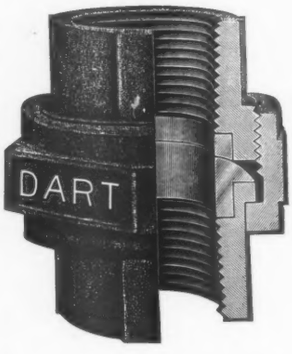

Outlast The Pipes They Join

The two bronze-to-bronze seats, ground together, make an accurate fit and eliminate all possibility of corrosion. Extra heavy malleable pipe ends surmounted by a heavy swivel tightening nut, make the Dart Union a single, unleaking unit.

We'll be glad to send you a Dart Union FREE. Tell us what size you want.

E. M. DART MFG. COMPANY
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Canadian Factory, Dart Union Co., Ltd., Toronto, Canada

This Tender Hose Saves Replacement

TENDER hose, in order to give perfect service, must be made to meet varying conditions at all times.

Especially is this true of the winter service that all tender hose should withstand.

Snow and ice on the outside of the hose and hot water and steam within present two extremes that will punish and break down the material unless it is made to meet these very conditions.

Snow, ice, sleet, or rain on the outside with hot water or steam on the inside will not affect Goodyear Tender Hose. It is made to stand up under these extremes.

Goodyear Tender Hose

is made with a wall containing real Car Heat Specification Steam Tube and Friction. There is a balance of construction that takes care of weather and climatic extremes, so compounded as to resist stiffening in severe cold.

Aside from hose made under a few railroad specifications, Goodyear Tender Hose is the only hose made in the manner described. Tanks can be thawed with this hose without injury.

Large trunk lines find it economical to use a hose of this specification all the year.

Save the cost and inconvenience of frequent replacement by using Goodyear Tender Hose. It is made to wear well in all kinds of weather and under all kinds of treatment.

The Goodyear Tire & Rubber Co., Akron, Ohio

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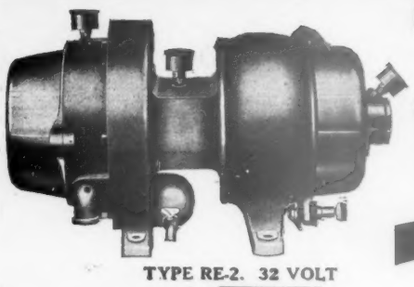
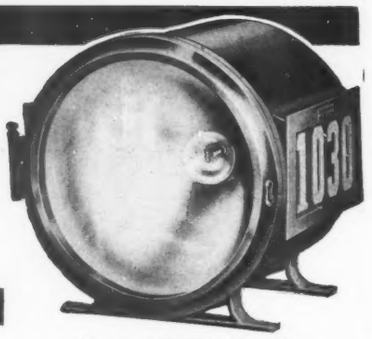
AKRON

Rubber Goods for Railway Purposes



TYPE RE-2. 32 VOLT

"THE LIGHT THAT'S RIGHT"



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Write for full information. The facts are interesting and will convince you that it's "The Light That's Right."

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VAPOR SYSTEM OF CAR HEATING

Direct Steam Heat without any pressure on the radiating pipes. Pressure retained in train pipe. Considerably less drain on the locomotive.

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U S G Co's Mexican Boiler Graphite—a safe, sane, mechanically acting scale remedy that will accomplish its work thoroughly, economically and without danger to the boilers.

U S G Co's Mexican Graphite Front End Lustre—affords a bright, glossy finish, is easily and quickly applied and durable. It is a lustre and not a paint, therefore it does not bake and cake on to front ends. Wears evenly and smoothly.

U S G Co's Mexican Graphite Paint—will last longer and cover more surface than any other paint on the market.

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U S G Co's Graphite Air Brake Lubricant—without a superior as a lubricating factor of the air brake system. Especially adapted to triple valve and brake cylinder lubrication.

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Because it stands severe service and affords real economy.

Yes! Go on.

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Because every square inch of Du Pont Fabrikoid is as good as the inch next to it—*and that's mighty good.* On the other hand, examination of a hide in various places shows plainly that the strength is seldom the same in any two places.

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Du Pont Fabrikoid fills the bill for railroad uses, and incidentally reduces the bills at the same time. Further, that every M.C.B. should acquaint himself with its superior qualities, which make Fabrikoid absolutely essential when the service which must be assured is considered.

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Make This Test

Its Cost Is Negligible

Equip only the right, or left hand, cylinders of twenty-five locomotives with

Watertown Automatic Cylinder Cocks

leaving the standard cylinder cocks on the other side.

Then for three or six months, a year if you wish, keep a careful record of repairs to, not only the cocks, but the cylinders, cylinder heads and packing.

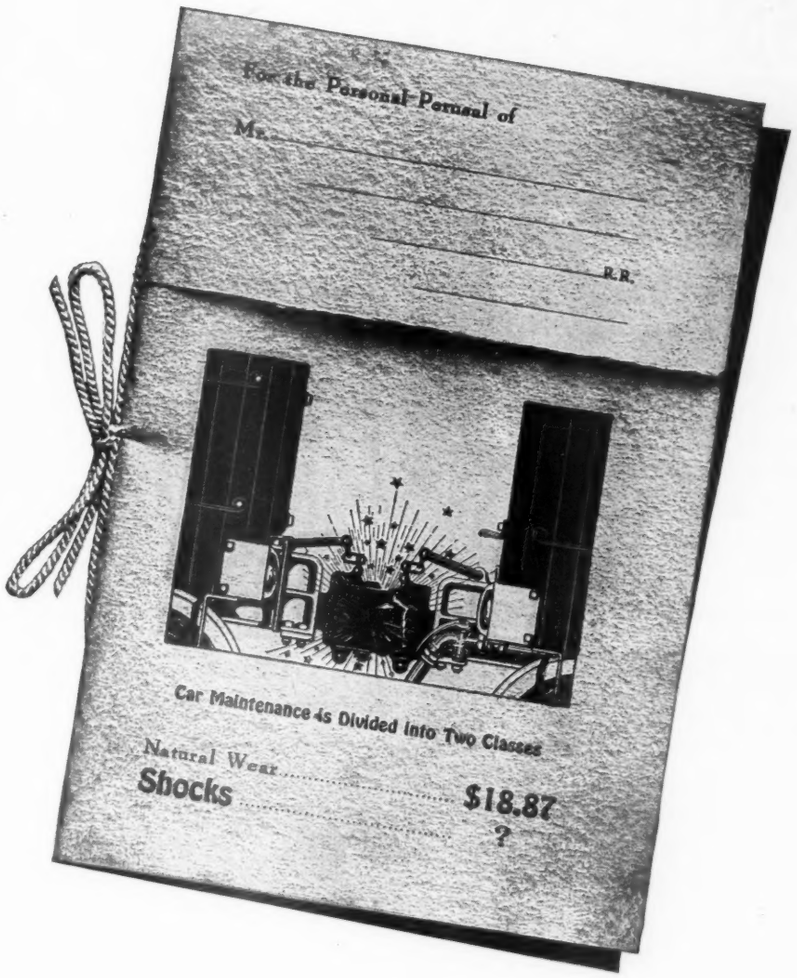
In order that this test shall cost you no more than if you were equipping with standard cocks, we will furnish you the necessary number of cocks to make the test at the same price as your regular cocks cost you. We only ask that you equip a sufficient number of locomotives to make a fair trial.

When you have conducted the test sufficiently long, compare the cost of repairs to those cylinders equipped with WATERTOWN COCKS with those having the standard cock, and if you are not convinced that the WATERTOWN COCK will more than save its cost we will take back the cocks you bought for the test at the price you paid for them.

If you are interested enough to make this test, let us hear from you so that we may arrange to send you the proper size and pattern cock to meet your requirements.

Watertown Specialty Company

WATERTOWN, N. Y.



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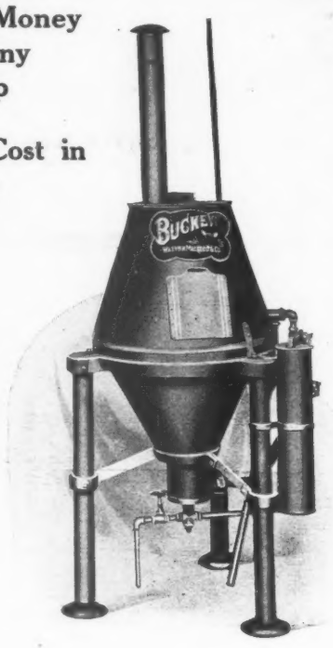

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Reduce wheel flange wear, rail wear and train resistance

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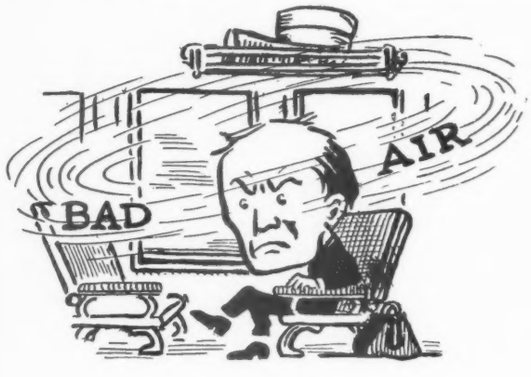

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Roads which are competing for passenger traffic—successfully—use

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because they are built on absolutely scientific principles and of the best materials. Their ease of installation, simplicity of construction and efficient service, whether the car is standing or traveling 20 miles an hour, recommend them to car builders and designers. Complete information and prices on request.

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